ENVIRONMENTAL ASSESSMENT

LIGHTWEIGHT EXOATMOSPHERIC PROJECTILE (LEAP) TEST PROGRAM

STRATEGIC DEFENSE
INITIATIVE ORGANIZATION

JULY 1991

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The environmental assessment (EA) includes an analysis of the environmental consequences of conducting activities in support of the Lightweight Exoatmospheric Projectile (LEAP) Test Program. All potentially significant environmental impacts from LEAP ground, preflight, and flight test activities will be mitigated to non-significant levels by implementing standard plan safeguards.

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ENVIRONMENTAL
ASSESSMENT

LIGHTWEIGHT EXOATMOSPHERIC PROJECTILE (LEAP) TEST PROGRAM

STRATEGIC DEFENSE
INITIATIVE ORGANIZATION

JULY 1991

COVER SHEET

Responsible Agency:	Strategic Defense Initiative Organization (SDIO)
Cooperating Agencies:	U.S. Army Strategic Defense Command, USA U.S. Department of the Air Force
Proposed Action:	Lightweight ExoAtmospheric Projectile (LEAP) Test Program
Responsible Individual:	William L. Noll Environmental Coordinator SDIO/TNE Washington, D.C. 20301-7100
Designation:	Environmental Assessment

Abstract:

The National Environmental Policy Act (NEPA), the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR 1500 - 1508), and U.S. Department of Defense (DoD) Directive 6050.1 direct that decision-makers take into account environmental consequences when authorizing or approving major federal actions. This environmental assessment (EA) includes an analysis of the environmental consequences of conducting activities in support of the Lightweight ExoAtmospheric Projectile (LEAP) Test Program.

The proposed action is to design, develop and demonstrate launch vehicles capable of intercepting targets in the exoatmosphere. The LEAP Test Program is funded to demonstrate the viability of this technology. Launch activities to support the LEAP Test Program will occur at White Sands Missile Range (WSMR), New Mexico, U.S. Army Kwajalein Atoll (USAKA), and Wake Island. Component/assembly ground tests will take place at Space Data Division (SDD), Chandler, Arizona; Phillips Laboratory, Edwards Air Force Base, California; Boeing Aerospace and Electronics, Kent, Washington; and Hughes Aircraft Corporation, Missile Systems Group, Canoga Park, California.

Availability: Unclassified. Available July 1991.

FINDING OF NO SIGNIFICANT IMPACT
(FONSI)

FINDING OF NO SIGNIFICANT IMPACT

STRATEGIC DEFENSE INITIATIVE ORGANIZATION

U.S. DEPARTMENT OF DEFENSE

Agency:	Strategic Defense Initiative Organization (SDIO) Department of Defense (DoD)
Cooperating Agencies:	U.S. Army Strategic Defense Command, USA U.S. Department of the Air Force
Action:	Lightweight ExoAtmospheric Projectile (LEAP) Test Program

Background: Pursuant to Council on Environmental Quality Regulations (40 CFR 1500-1508) for implementing the procedural provisions of the National Environmental Policy Act (42 U.S.C. 4321 et. seq.), and Department of Defense directives on environmental effects of DoD actions, SDIO has conducted an assessment of the potential environmental consequences of conducting the LEAP Test Program to demonstrate the viability of technology and its applicability to a Strategic Defense System.

Summary: A series of flight tests are needed to demonstrate and evaluate the advanced technologies necessary to determine whether a potential exoatmospheric interceptor system is feasible. Such a determination cannot be made based on analysis, simulations or ground testing alone.

As currently configured, the LEAP Program will consist of flight experiments with Aries rocket vehicles launched from White Sands Missile Range (WSMR), and U.S. Army Kwajalein Atoll (USAKA); and Castor IV rocket vehicles from Wake Island. Existing launch facilities will be used at these locations. WSMR and USAKA have previously been used to launch Aries vehicles.

Additional activities will be conducted at several locations in the United States in preparation for final assembly and checkout of the launch vehicles. These activities are categorized as component/assembly ground tests (including design, fabrication, and component environmental tests), and preflight activities and tests (including component, final assembly and integration).

Test activities for the proposed action will be performed at the following locations:

Installation	Test Type
Space Data Division Orbital Sciences Corporation Chandler, AZ	Component/Assembly Ground Tests
Hughes Aircraft Company Missile Systems Group Canoga Park, CA	Component/Assembly Ground Tests
Phillips Laboratory Edwards Air Force Base, CA	Component/Assembly Ground Tests
Boeing Aerospace and Electronics Kent, WA	Component/Assembly Ground Tests
White Sands Missile Range, NM	Preflight, Flight Tests
U.S. Army Kwajalein Atoll Marshall Islands	Preflight, Flight Tests
Wake Island	Preflight, Flight Tests

The potential for significant impacts was determined through an analysis of the activities that would be conducted at the proposed locations, compared to current activities and existing conditions at those locations. The impacts of the proposed action were assessed against the following environmental media: physical setting and man-made environment; geology and water resources; air quality; noise; biological resources; threatened and endangered species; cultural resources; infrastructure; hazardous materials and waste; and safety. The methodological approach consisted of identification of potential environmental issues and the determination as to their significance. For issues that were identified as potentially significant after application of standard engineering practices, planned mitigation measures were incorporated into the program. For these issues that were still potentially significant, environmental analyses of impacts were conducted. These impacts were then reviewed to determine if they were mitigable to non-significant levels.

Findings:

All potentially significant impacts from LEAP ground, preflight, and flight test activities will be mitigated to non-significant levels by implementing standard plan safeguards. These mitigations have been incorporated into the LEAP Program as an integral part of program-related operations at WSMR, USAKA, and Wake Island. Potential land use, water resources, biological, soils, and safety issues concern the release of liquid propellant in various forms of hydrazine.

The LEAP Program has adopted spill control, containment and handling and disposal practices which will reduce the risks of releasing liquid propellant into the environment. Appropriate personal protection devices will be used during fueling/defueling and purging operations.

Potential noise impacts from LEAP launches and ground activities will be mitigated by ensuring that personnel wear hearing protection equipment which will reduce noise levels to the prescribed health and safety levels. Furthermore, personnel will be protected from blast noise during launches by moving beyond the calculated safety distance. Base personnel at WSMR, USAKA and Wake Island will not be exposed to noise levels in excess of OSHA allowable short-term limits. Accidental explosion of a rocket booster on the launch pad or shortly after launch could pose a hazard to personnel in the vicinity of the launch area. The Range Safety Officer (RSO) will mitigate the potential for such a hazard by ensuring that the explosive quantity safety distance for each rocket launch is implemented and monitoring the hazard area to prevent unauthorized entry.

In order to minimize potentially significant impacts on the biological environment at WSMR, LEAP launches will operate within operational criteria of on-going activities at the range.

Potential impact from debris recovery will be prevented by retrieving debris by way of access corridors which will be surveyed for threatened and endangered species, and cultural resources prior to the recovery of the debris. The corridors will be realigned if necessary to avoid impacts. If unacceptable impacts cannot be avoided, debris will be recovered by helicopter or left in place. Other mitigation measures that will be implemented include: ensuring that no recovery operation will be undertaken at the Salt Creek area, where the White Sands pupfish is located, without the concurrence of the Chief, Range Support Section, and the Chief, Environmental and Natural Resources Division at WSMR. Under no circumstances will any vehicles enter within 400 meters of Salt Creek unless the Officer in Charge (OIC) or Noncommissioned Officer in Charge (NCOIC) of the recovery team has personally coordinated the matter with the Environmental Chief or his authorized representative.

The No Action Alternative for the proposed activity would preclude a series of flight tests that are needed to demonstrate and evaluate the advanced technologies necessary to determine whether a potential exoatmospheric interceptor system is feasible. The No Action Alternative is not to continue the LEAP Program. Additional LEAP flights would not occur at WSMR, USAKA and Wake Island installations.

Overall, no significant impacts would result from conducting the LEAP Test Program at WSMR, USAKA, Wake Island, or ground support locations. Therefore no environmental impact statement will be prepared for the proposed action.

Point of Contact:

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Approved: ______________________

Date: 6-25-91

for DENNIS E. O'BRIEN, COL. OD, DC
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Approved: ______________________

Date: 7/18/91

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Director, SDIO

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The Strategic Defense Initiative Organization (SDIO) was established to plan, organize, coordinate, direct, and enhance research and testing of capabilities of technologies applicable to a Strategic Defense System (SDS) of ballistic missile defense. The research activities are collectively known as the Strategic Defense Initiative (SDI).

SDIO is proceeding with research and testing activities associated with the Lightweight ExoAtmospheric Projectile (LEAP) Test Program and has identified a need to validate technologies as capable of satisfying strategic defense interceptor element requirements.

The proposed action is to design, develop, and demonstrate space test projectiles capable of intercepting targets in the exoatmosphere. As currently configured, the LEAP Program will consist of flight experiments with Aries rocket vehicles launched from White Sands Missile Range (WSMR), and U.S. Army Kwajalein Atoll (USAKA); and Castor IV rocket vehicles from Wake Island. Existing launch facilities will be used at these locations. WSMR and USAKA have previously been used to launch Aries vehicles.

The LEAP Test Program will include component/assembly grounds tests, pre-flight activities, and flight test activities. Proposed locations for testing include: Space Data Division (SDD), Chandler, Arizona; Phillips Laboratory, Edwards Air Force Base, California; Boeing Aerospace and Electronics (BAE), Kent, Washington; and Hughes Aircraft Corporation (HAC) Missile Systems Group, Canoga Park, California. Minor construction/modification of test facilities at Phillips Laboratory will be necessary.

Alternatives considered but not carried forward included the use of other launch locations, other boosters, and the no action alternative. All LEAP test flights have been reviewed by the Treaty Compliance Group. The group has required that the third, fourth, fifth, and sixth test flights be flown from either WSMR or USAKA, which are Anti-Ballistic Missile (ABM) designated ranges. WSMR is an inland range which will allow SDIO to refurbish and fly again reusable LEAP components for subsequent LEAP flights as well as provide

the necessary ......umentation to support the flight experiments. Additionally, launches of Aries vehicles at WSMR are routine, thus reducing range safety risks associated with LEAP flights.

For future LEAP experiments, flyout over sea will be required to allow for a greater range within which the experiments can occur. USAKA provides the optimum range to launch over water because it also has a launch silo built for Aries vehicles. USAKA also provides optimum radar collection capabilities to support the LEAP flights.

While numerous boosters were considered for the LEAP Test Program, the Aries and Castor IV boosters provided the optimum booster performance envelope, meeting payload and test range requirements, to support LEAP experiment exoatmospheric profiles and timelines.

The impacts of the proposed action were assessed against the following environmental media:

- Physical Setting and Man Made Environment
- Geology and Water Resources
- Air Quality
- Noise
- Biological Resources
- Threatened and Endangered Species
- Cultural Resources
- Infrastructure
- Hazardous Materials and Wastes; and
- Safety

The analysis was conducted in two phases: 1) program impacts from the technology; and 2) specific test facility impacts.

Program impacts from LEAP activities will be avoided or minimized through implementation of appropriate mitigation measures or through modification of the technology design testing procedures. For example, a small amount of liquid bipropellant, hydrazine or monomethylhydrazine and nitrogen tetroxide will be used in the experiments. Handling will be by personnel trained in the safety measures relating to the transportation and fueling process of these liquid fuels. Special fueling rooms will be used as a part of the LEAP Program in order to maximize safety. Therefore no significant impacts are expected.

For the site specific analysis, impacts resulting from LEAP activities will be avoided or minimized by modification of test procedures or protection of potentially affected resources. For example, mitigation measures have been designed for recovery of post-flight LEAP debris in a manner designed to minimize impacts to sensitive resources. These would include survey of access corridors to the debris to minimize disturbance to cultural resources and possible threatened and endangered species by land vehicle recovery. Implementation of these measures would lead to no significant impact at the site specific level.

Component/assembly ground tests at existing facilities were found to be within the normal scope of activities routinely conducted at those facilities and no significant environmental impacts are expected. Pre-flight and flight activities planned for WSMR, USAKA, and Wake Island will be conducted at existing facilities.

In 1989, the U.S. Army prepared an installation EIS for USAKA. The USAKA EIS has been incorporated into this document by reference and summarized in the appropriate sections. Changes in the affected environment subsequent to the publication of that document have also been included.

TABLE OF CONTENTS

LEAP ENVIRONMENTAL ASSESSMENT
TABLE OF CONTENTS

LEAP ENVIRONMENTAL ASSESSMENT
TABLE OF CONTENTS (continued)

Page

LEAP ENVIRONMENTAL ASSESSMENT
TABLE OF CONTENTS (continued)

LEAP ENVIRONMENTAL ASSESSMENT
TABLE OF CONTENTS (continued)

ACRONYMS

LIST OF ACRONYMS

Acronym	Description
ABM	Anti-Ballistic Missile
ACGIH	American Conference of Governmental Industrial Hygienists
ACHP	Advisory Council on Historic Preservation
ACS	Attitude Control Subsystem
AFATL	Air Force Armament and Test Laboratory
AFB	Air Force Base
AFSTC	Air Force Space Technology Center
ALIVE	Army LEAP Integrated Validation Program
AR	Army Regulation
ARDEC	Armament Research Development Engineering Command
ARMTE	Army Material Test and Evaluation Directorate
ATP	Acquisition, Tracking, and Pointing
BAE	Boeing Aerospace and Electronics
BLM	Bureau of Land Management
CCAFS	Cape Canaveral Air Force Station
CONUS	Continental United States
db	Decibel
dBA	Decibel (A-weighted)
DNL	Day/Night Noise Level
DA	Department of Army
DoD	Department of Defense
DOE	Department of Energy
DOPAA	Description of Proposed Action and Alternatives
DOT	U.S. Department of Transportation
EA	Environmental Assessment
ECIS	Environmental Critical Issues Summary

EIAP	Environmental Impact Analysis Process
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ERIS	Exoatmospheric Reentry Vehicle Interceptor Subsystems
ESQDs	Explosives Safety Quantity Distances
EXCEED	Electron Accelerator Experiment
F	Fahrenheit
FONSI	Finding of No Significant Impact
GBFEL-TIE	Ground Based Free Electron Laser Technology Integration Experiment
GFE	Government Furnished Equipment
GN_2	Cold Gas Nitrogen
GSTS	Ground-Based Surveillance and Tracking System
HAC	Hughes Aircraft Company
HEDI	High Endoatmospheric Defense Interceptor
HPP	Historic Preservation Plan
IMU	Inertial Measuring Unit
IR	Infrared
KEW	Kinetic Energy Weapons
KFIT	Kinetic Flight Integration Test
KHIT	Kinetic Hover Interceptor Test
km	Kilometer
kW	Kilowatt
LAE	LEAP Auxiliary Equipment
lbm	Pounds Mass
LC	Launch Complex
L_{eq}	Average Sound Level
Ldn	Day-Night Average Sound Level
LEAP	Lightweight Exoatmospheric Projectile
LEB	Launch Equipment Building
LIFE	Lightweight Exoatmospheric Projectile Integrated Flight Experiment
LN_2	Cryogenic Liquid Nitrogen

LOCC	Launch Operations Control Center
LONOTES	Local Notices to Mariners
LPX	Liquid Plume Experiment
LSB	Launch Support Building
LSE	Launch Support Equipment
MAB	Missile Assembly Building
MFSOP	Missile Flight Safety Operational Plan
mg/m^3	Milligrams Per Cubic Meter
mg/l	Milligrams Per Liter
MMH	Monomethylhydrazine
MOA	Memorandum of Agreement
MOCF	Mission Operations Checkout Flight
MRTFB	Major Range Testing Facility Base
MSA	Metropolitan Statistical Area
MWIR	Medium Wave Infrared
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NEW	Net Explosive Weight
NHTF	National Hover Test Facility
NIOSH	National Institute of Occupational Safety and Health
NMFS	National Marine Fisheries Service
NOI	Notice of Intent
NCOIC	Noncommissioned Officer in Charge
NOMTS	Naval Ordnance Missile Test Station
NRO	National Range Operations
NWR	National Wildlife Refuge
OIC	Officer in Charge
OSC	Orbital Sciences Corporation
OSHA	Occupational Safety and Health Administration
PM	Payload Module

PMB	Payload Module Bus
PM10	Particulate Matter Less Than 10 Microns in Diameter
PPM	Parts Per Million
PMOA	Programmatic Memorandum of Agreement
POL	Petroleum Oil and Lubricants
PTL	Probe Testing Laboratory
PWL	Sound Power Level
RCRA	Research Conservation and Recovery Act
RGCOG	Rio Grande Council of Government
RMI	Republic of the Marshall Islands
ROD	Record of Decision
ROI	Region of Influence
RSO	Range Safety Officer
SBI	Space Based Interceptor
SCS	Soil Conservation Service
SDD	Space Data Division
SDI	Strategic Defense Initiative
SDIO	Strategic Defense Initiative Organization
SDS	Strategic Defense System
SHPO	State Historic Preservation Officer
SOP	Standard Operating Procedure
SPL	Sound Pressure Level
SSOP	Safety Standing Operating Procedures
STP	Space Test Projectile
TBAM	Target Booster Assist Module
TECOM	U.S. Army Test and Evaluation Command
TLV	Threshold Limit Value
TM	Technical Manual
TNS	Sensor and Interceptor Technology Directorate
TVP	Technology Validation Program
USAF	United States Air Force

USAKA	U.S. Army Kwajalein Atoll
USASDC	U.S. Army Strategic Defense Command
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WSMR	White Sands Missile Range
WSTF	White Sands Test Facility (NASA)

1.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

LEAP PROGRAM ENVIRONMENTAL ASSESSMENT

1.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

The National Environmental Policy Act (NEPA), the Council on Environmental Quality Regulations implementing NEPA (40 CFR 1500-1508), and the U.S. Department of Defense (DoD) Directive 6050.1 direct that DoD officials take into account environmental consequences when authorizing or approving major Federal actions. This environmental assessment (EA) presents an analysis of the environmental consequences of conducting activities in support of the Lightweight ExoAtmospheric Projectile (LEAP) Test Program.

Section 1.0 of this EA describes the purpose and need for the proposed action, the proposed action, and alternatives, including the no-action alternative. Section 2.0 describes the environment to be affected by the proposed action. Section 3.0 assesses the potential environmental consequences of the proposed activities on the environmental components identified in Section 2. If a particular activity has the potential to have a significant effect on the environment, mitigation measures have been incorporated into the proposal to reduce the potential significant effects to insignificant levels. These mitigation measures will be implemented as part of the proposal.

1.1 PURPOSE AND NEED FOR THE PROPOSED ACTION

As part of its responsibilities for developing a viable and effective Strategic Defense System (SDS), the Strategic Defense Initiative Organization (SDIO) must demonstrate the capability to acquire, track, and intercept targets from various trajectories at varying altitudes. The LEAP Test Program is an SDI experiment program being funded to demonstrate compliance with this requirement.

The purpose of the LEAP Test Program is to design, develop, and demonstrate the capability of a miniaturized, lightweight projectile to intercept targets in the exoatmospheric

region. These tests are required so that the SDIO Director can make a decision concerning the effectiveness of these technologies and their role in a strategic defense system.

1.2 PROPOSED ACTION

The proposed action is to design, develop, and demonstrate space test projectiles capable of intercepting targets in the exoatmosphere. The LEAP Test Program is funded to demonstrate compliance with this requirement. Activities required to support this program are execution of component/assembly tests, pre-flight activities, and flight test activities. Additionally, construction of test facilities at Phillips Laboratory on Edwards Air Force Base (AFB), and modification of launch facilities at Wake Island will be required.

The following discussion is a brief description of the concept of the LEAP technology program and a detailed description of the activities required to support the proposed action for these technologies. The proposed action also covers activities which include the manufacture of flight test articles unique to the experiments, and the operation of relevant facilities at the host installations.

1.2.1 Background and Concept of the LEAP Test Program

The LEAP projectile is a miniaturized projectile being designed by several program participants and integrated by SDIO for demonstration. Other interceptor technology programs, such as the Exoatmospheric Reentry Vehicle Interceptor Subsystem (ERIS), have demonstrated that a large interceptor vehicle is capable of intercepting targets in the exoatmosphere; however, the main objective of the LEAP Test Program is to demonstrate the possibility of interception by a lightweight, miniature vehicle.

Two technological approaches to the development of LEAP technologies are simultaneously under investigation. The first approach is being coordinated by the U.S. Air Force through the Phillips Laboratory, Edwards AFB, California. The second is being coordinated by the U.S. Army through the U.S. Army Strategic Defense Command. The approaches are

similar and both employ liquid bi-propellant engines for divert maneuvering. The liquid bipropellants used are hydrazine or monomethylhydrazine as the fuel and nitrogen tetroxide as the oxidizer. They differ only in the avionics technology applied to the projectile's sensor, guidance, stabilization, and control subsystems (SDIO/TNS, 1990).

Execution of the LEAP Test Program will take place at the following facilities: Boeing Aerospace and Electronics, Seattle, Washington; Hughes Aircraft Company, Missile Systems Group, Canoga Park, California; Orbital Sciences Corporation, Space Data Division, Chandler, Arizona; Phillips Laboratory, Edwards AFB, California; White Sands Missile Range (WSMR), New Mexico; U.S. Army Kwajalein Atoll (USAKA); and Wake Island.

As currently configured, the LEAP Program will consist of ground tests, four test flights with rocket vehicles launched from White Sands Missile Range (WSMR), New Mexico (Figures 1 and 2) and two test flights at U.S. Army Kwajalein Atoll (USAKA) (Figure 3) with the target launches from Wake Island (Figure 4).

Existing launch facilities (Launch Complex [LC 36] and Sulf Site at WSMR, Meck Island at USAKA, and Wake Island) will be used at all locations. The launches proposed for USAKA will be examined in the context of existing environmental documentation. Specifically, the Environmental Impact Statement (EIS) for Proposed Actions at U.S. Army Kwajalein Atoll (USASDC, 1989a) is summarized in the appropriate sections. The mission profiles for LEAP launches at USAKA are identified in Section 1.2.5.1 of this document. If, through further planning and design, the scope of these later flights is different than those analyzed in this document, further environmental documentation would be prepared.

1.2.2 Construction

Minor construction and modification activities are associated with the LEAP Test Program. This includes expansion of a component/assembly and testing facility at Phillips Laboratory and modification of existing launch facilities on Wake Island.

1.2.2.1 Phillips Laboratory

Component/Assembly and testing activities at Phillips Laboratory to support the LEAP Program will require the modification of test facilities and construction of a new integration area.

The proposed integration area would consist of a new 4,000 square foot enclosure, 80 feet long and 50 feet wide. The enclosure would contain a clean room for vehicle integration, work areas for electronics integration, and storage areas. No explosives storage or handling activities would occur in the new area.

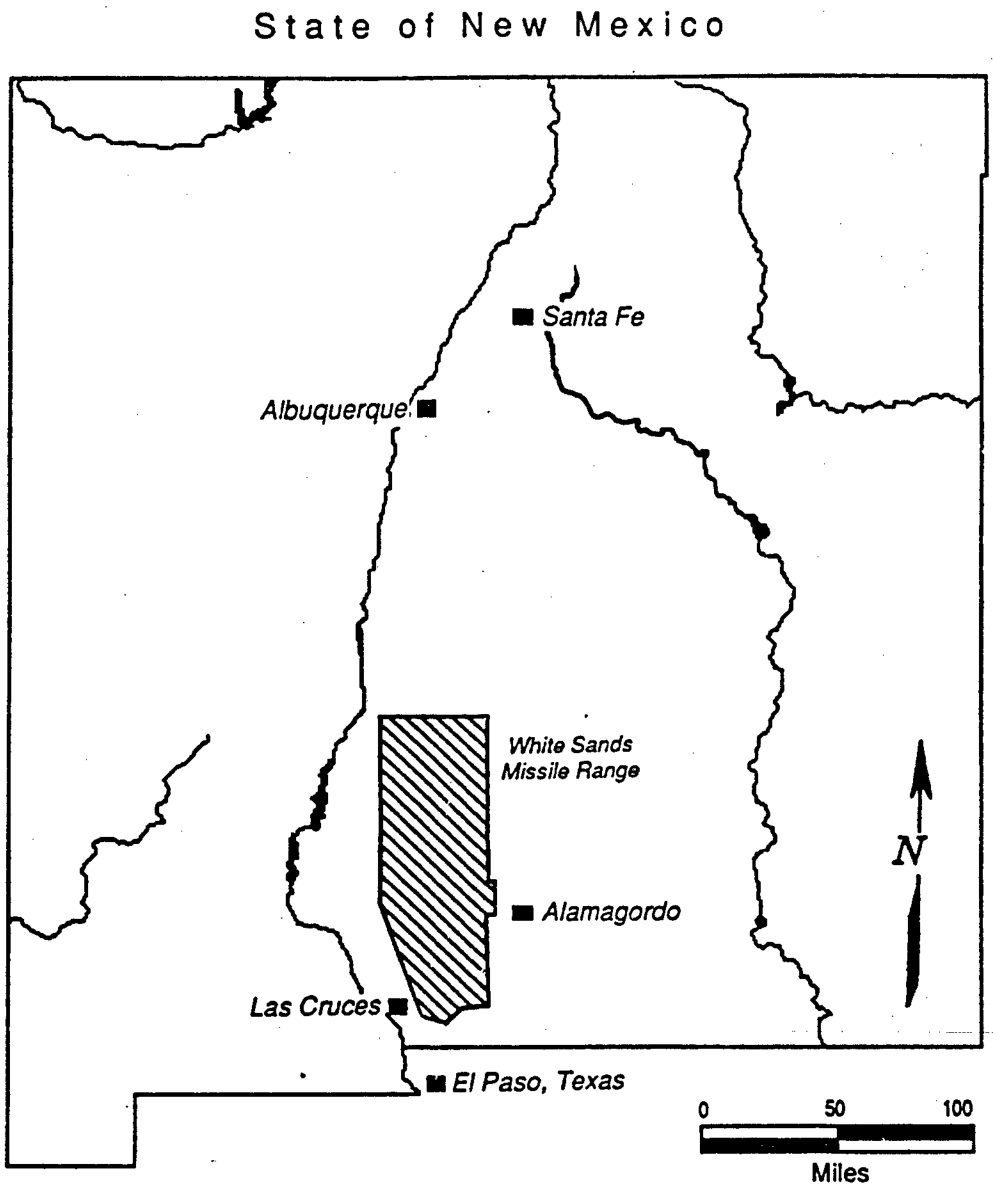
The new facility will be constructed adjacent to the existing control room (Building 8840). The area where the expansion will occur has previously been graded. Existing utilities will be used to provide water, power, and sewer services to the expanded structure.

1.2.2.2 Wake Island

Target launches at Wake Island will require the modification of some new facilities and the remodeling of selected existing facilities. Required modification activities are described herein.

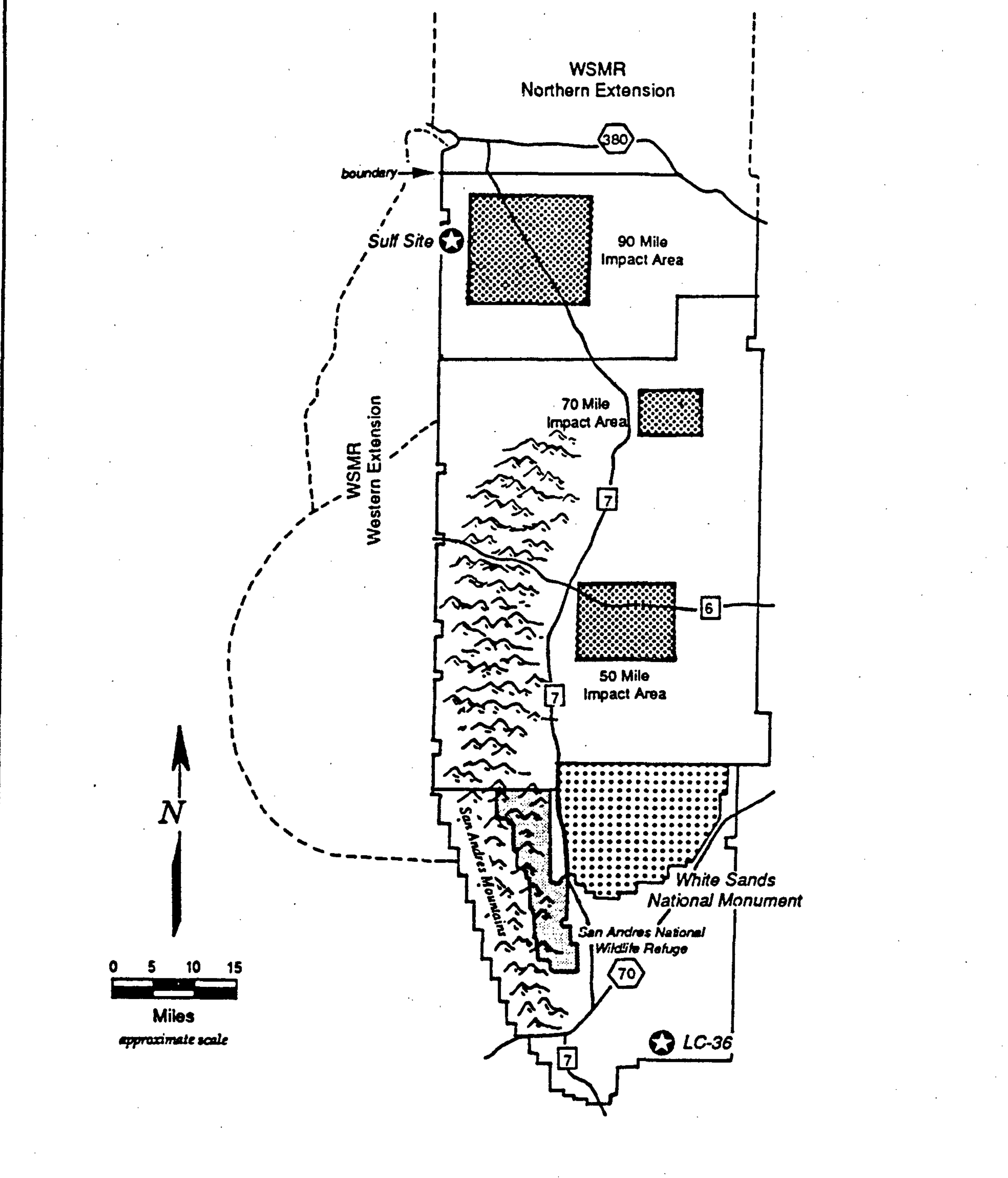
Existing facilities at Wake Island were constructed for the Starbird program for launches on a 62° launch azimuth. LEAP target flights, which will launch on a 140° launch azimuth, will use Starbird facilities (assessed in USASDC, 1987). These facilities will require modification to accommodate a different booster and launch azimuth.

Figure 5 shows the principal airfield activity areas on Wake Island and the proposed locations of new activities. Additional land for the LEAP launches will not be required because Starbird and existing base facilities will be modified to meet the programs' specifications. Mitigation measures for Starbird activities on Wake Island have already



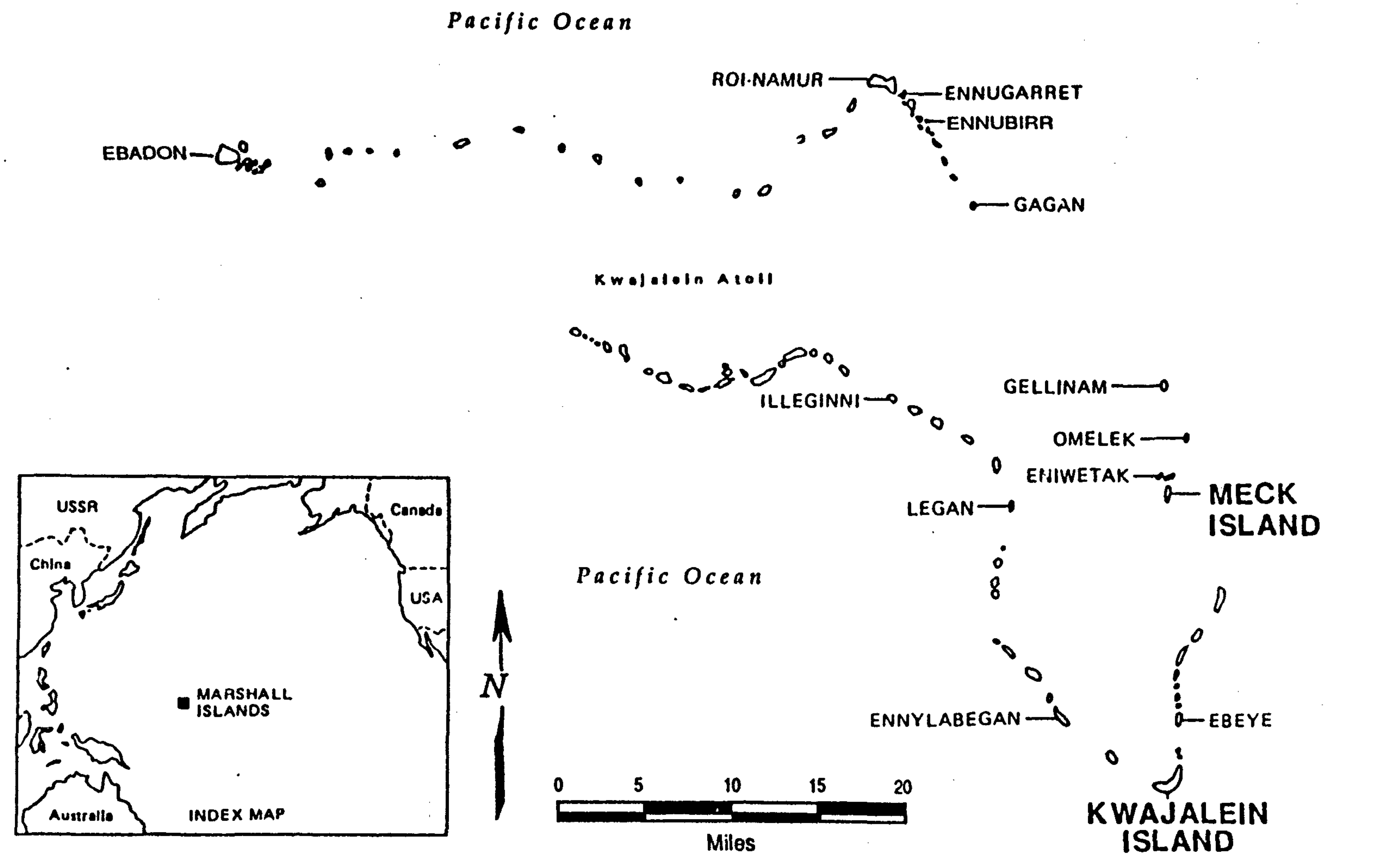
LEAP ENVIRONMENTAL ASSESSMENT	NEW MEXICO AND WHITE SANDS MISSILE RANGE

Figure 1



LEAP ENVIRONMENTAL ASSESSMENT	WHITE SANDS MISSILE RANGE

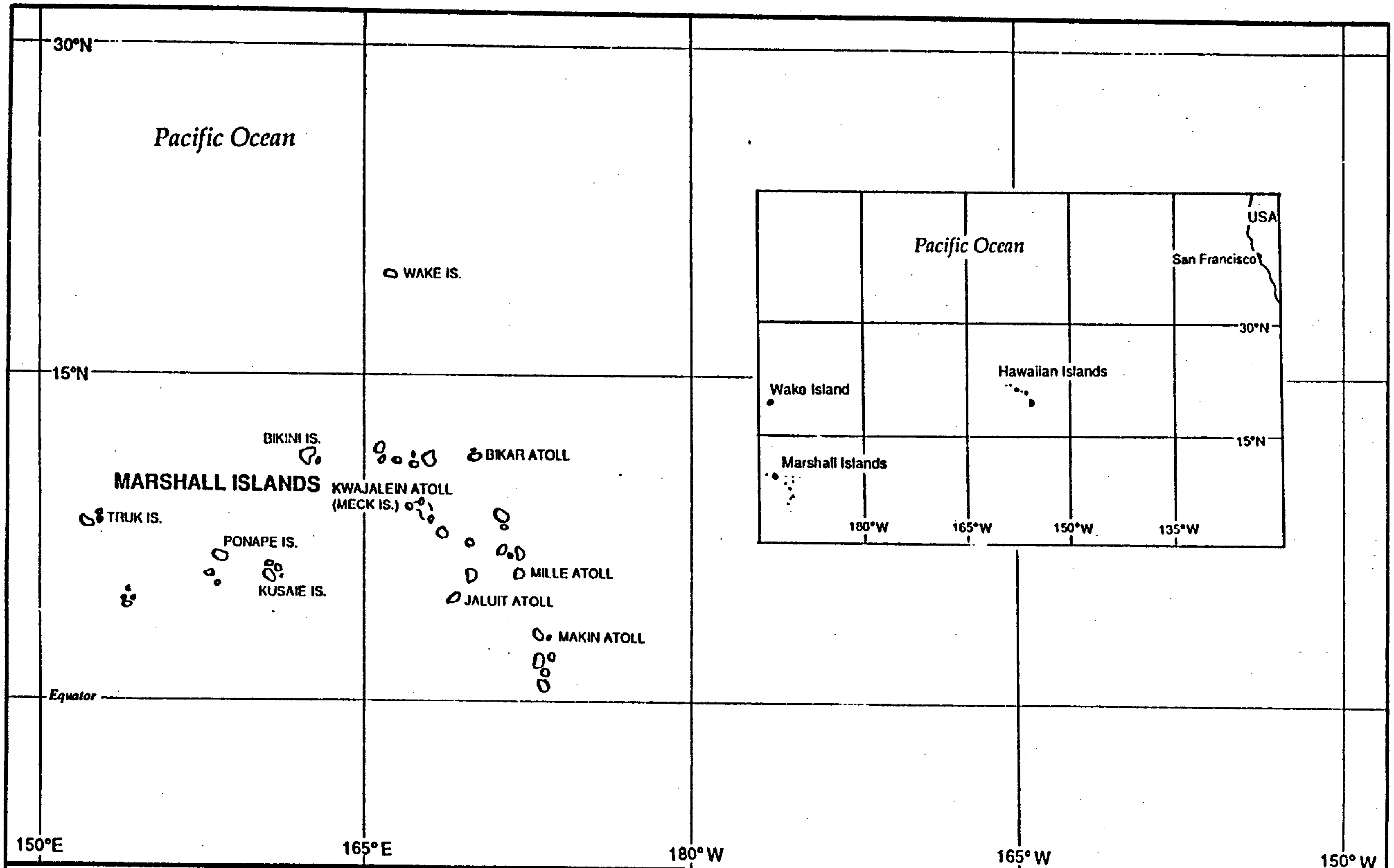
Figure 2



Source: SDIO, 1987.

LEAP ENVIRONMENTAL ASSESSMENT	KWAJALEIN ATOLL

Figure 3



LEAP ENVIRONMENTAL ASSESSMENT

LOCATION OF WAKE ISLAND

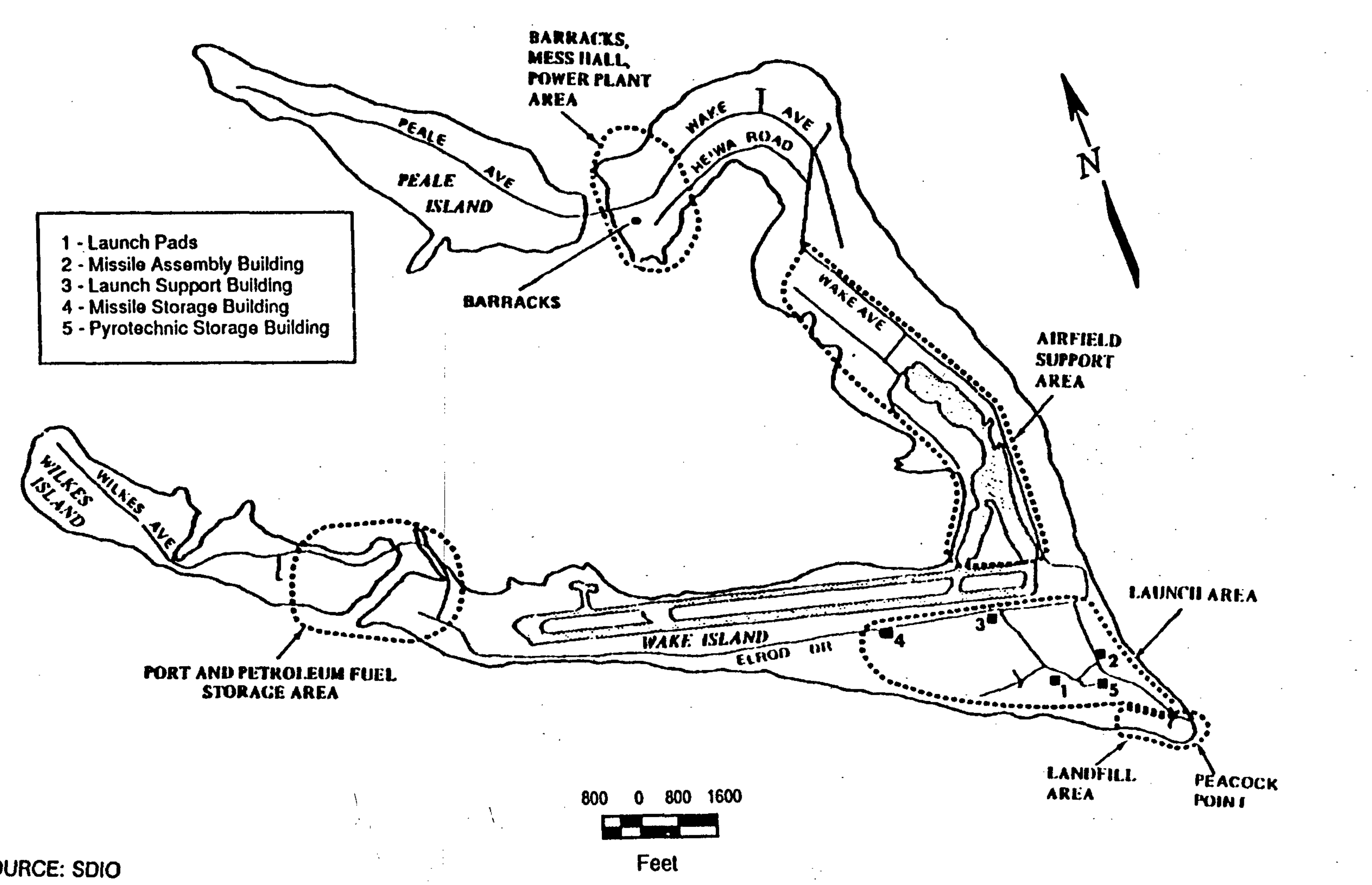
Figure 4

been adopted (USASDC, 1987) or have been agreed upon by the Advisory Council on Historic Preservation (ACHP) and the U.S. Fish and Wildlife Service (USFWS). These measures were primarily motivated by the historic stature of Wake Island's role during World War II and the possible presence of protected species on the island and in its near-shore waters. The mitigation measures require the use of existing facilities where possible, minimum disturbance of the environment, limitation on human intrusion into certain undisturbed parts of Wake Island, and specific protection and monitoring activities to minimize disturbance to cultural resources and protected species. LEAP related activities at Wake Island are similar in scope to those of the Starbird program, and as such these mitigations are incorporated into the LEAP program to protect biological and cultural resources at Wake Island.

The LEAP program activities will occur at eight facilities that were constructed, renovated, or provided for the Starbird Program: 1) Launch Pad 1; 2) the Missile Assembly Building (MAB); 3) the Launch Support Building (LSB); 4) the Missile Storage Building (MSB); 5) the Pyrotechnic Storage Building (PSB), launch control equipment at the Mobile Real Time System (MRTS) site, and the radar/telemetry sites. In addition, a Personnel Barrack will be renovated to house temporary personnel. All but the MSB, PSB, and MRTS will require modifications to support LEAP; however, these will be minor and will be conducted by the on-site operations contractor.

The Missile Assembly Building will be modified for the LEAP target flights. A thru-wall air conditioning system, requiring a "lean to" for the mechanical room, will be installed. In addition, the hibay louvers will be sealed, the bridge crane will be load tested and refurbished, and the battery room will be refurbished.

Launch Pad 1 will be modified for LEAP use. These modifications result from the change from launches to the northeast (Starbird) to launches to the southeast (LEAP). Conduits for control systems must be relocated due to the changed azimuth; therefore, cable trays and a launch equipment building (LEB) foundation must be constructed. In addition,



SOURCE: SDIO

LEAP ENVIRONMENTAL ASSESSMENT

WAKE ISLAND, WILKES ISLAND, AND PEALE ISLAND

Figure 5

lightning poles, pad conduits, pad mounted transformer switch and mechanical skids will be relocated as required. All modifications in the launch pad area will be minor and occur in areas previously disturbed for Starbird construction.

The old Wake Island Federal Aviation Administration (FAA) tower complex Building 1601 was renovated for the Starbird Launch Support Building. This renovated interior will be reconfigured for the LEAP Launch Operations Control Center (LOCC).

Temporary areas prepared for use of mobile Starbird radar/telemetry equipment are planned to be used for LEAP flights. Because of the different launch azimuth, LEAP launches may require different Radar/Telemetry Sites than the previously proposed Starbird launches. Final radar and telemetry sites for LEAP launches are to be determined; however, it is intended that sites would be located in existing clear, level areas such as roadways, parking lots, or other areas that have been previously cleared and graded. Based on site reconnaissance, it is expected that such sites can be found and that no ground disturbance activities will be required. Radar/telemetry sites would be expected to be less than 0.25 acre in size.

If radar/telemetry sites are required to be located on Wilkes Island (Figure 5), nesting habitat of seabirds could be adversely affected by the proximity of the sites. However, mitigations adopted for the STARBIRD program will be used to minimize disturbances in these areas.

One existing Personnel Barrack (Building 1172 or 1173) will be renovated for the LEAP launches, requiring rework of the interior, which is in disrepair, and modest exterior renovations.

1.2.3 Component/Assembly Ground Test Activities

To support the LEAP Program, various ground tests will occur at contractor and Government facilities in the continental United States. The following discussion presents an overview of these ground test activities and the locations at which they occur (Table 1).

1.2.3.1 Boeing Aerospace & Electronics (BAE), Kent, Washington

BAE, located in Kent, Washington near Seattle, is responsible for the design, fabrication, inspection, assembly, interface tests, and integration of the LEAP projectile, including its avionics unit. This includes inspection and Air Force interface tests. Additionally, BAE will be involved in monitoring the vehicle assembled by SDD.

Existing areas at BAE will be used for the production of the Air Force LEAP components, component/assembly testing, and integration. These activities will occur in an existing facility that requires no modification or refurbishment. No additional personnel will be required to support LEAP activities. BAE has confirmed compliance with the Clean Air Act, the Clean Water Act, and other relevant Federal, state, and local regulations (Arbuckle, 1991).

1.2.3.2 Hughes Aircraft Company (HAC), Missiles Systems Group, Canoga Park, California

Hughes provides system level tests and integration of the Army LEAP projectile, integration of the auxiliary equipment and the LEAP, and tests of the auxiliary equipment in the LEAP prior to shipment to SDD. These are routine activities at Hughes. Component and assembly tests at Hughes include checkout of the LEAP auxiliary equipment, which consists of power supplies and auxiliary cryogenic refrigeration, and pre-shipment tests of the auxiliary equipment and the LEAP projectile.

TABLE 1

LEAP TEST PROGRAM

LEAP	PLANNED LAUNCH DATE	LOCATIONS	TEST ACTIVITY	COMPONENT ASSEMBLY	PREFLIGHT FLIGHT
		Boeing Aerospace & Electronics Kent, Washington	Air Force Projectile Production Assembly Testing, Integration	X	
		Hughes Aircraft Company-Missile Systems Group, Canoga Park, CA	Army LEAP Projectile Production, Component/Assembly Testing, Integration	X	
		Space Data Division Chandler, AZ	Production of Launch Vehicle Components; Component/Assembly Testing; Component Integration	X	
		Phillips Laboratory Edwards AFB, CA	Component/Assembly Testing and Integration; LEAP Projectile Hover Testing	X	
1	July 91	White Sands Missile Range, NM	Integration and Checkout; Flight Test		X
2	Aug 91	White Sands Missile Range, NM	Integration and Checkout; Flight Test		X
3	Nov 91	White Sands Missile Range, NM	Integration and Checkout; Flight Test		X
4	FY92/93	White Sands Missile Range, NM	Integration and Checkout; Flight Test		X
5	FY92/93	U.S. Army Kwajalein Atoll, Marshall Islands, Wake Island	Integration and Checkout; Flight Test		X
6	FY93	U.S. Army Kwajalein Atoll, Marshall Islands, Wake Island	Integration and Checkout; Flight Test		X

No additional personnel will be required to support LEAP activities. The LEAP activities will occur in an existing facility that requires no modification or refurbishment. Hughes has all applicable Federal, state, and local permits and authorizations necessary for current operations (Smith, 1991).

1.2.3.3 Space Data Division (SDD), Orbital Sciences Corporation, Chandler, Arizona

Space Data Division provides flight test services for the integrated launch vehicles for all LEAP flight tests. At its Chandler facility, SDD is responsible for assembly, integration, and inspection of the launch vehicles including: avionics, interstage hardware and wiring, a payload module bus (PMB) that will contain the LEAP, propulsion systems, and target vehicles. SDD is also responsible for receipt, checkout, installation and integration of the LEAP projectiles with the payload bus units. They are responsible for final assembly checkout tests at the Chandler facility, and launch sites at WSMR, USAKA, and Wake Island. These final checkout tests are to determine system acceptance; basically, mechanical tests using vibration tables and thermal chambers of the primary technology elements.

Existing facilities at SDD will be used for LEAP Test Program activities and require no modification or refurbishment. No additional personnel are required to conduct LEAP related tests. SDD has all applicable Federal, state, and local permits and authorizations necessary for current operations (SDD, 1990).

Hazardous materials are managed in accordance with the Hazardous Materials Management Plan, Technical Manual (TM)-4789, dated 2 May 1990.

1.2.3.4 Phillips Laboratory, Edwards Air Force Base, California

Phillips Laboratory is responsible for acquiring and integrating vehicle hardware for the first LEAP Program flight at WSMR. Currently employed Phillips personnel will be involved in these activities. Phillips has all applicable Federal, state, and local permits and

authorizations necessary for current operations (Phillips, 1990). LEAP activities at Phillips will necessitate the construction of a new facility which is described in Section 1.2.3.1.

Strap down and hover tests will be performed at the Phillips National Hover Test Facility (NHTF). A strapdown test is a standard requirement for all vehicles which pass through the NHTF. The vehicle is secured to a test bench and test fired. This test is performed as a check for flaws in the propulsion system prior to a free flight test. The hover tests involve the LEAP resting on a cradle in a netted cage. The LEAP will use an artificial target, such as a light bulb, located approximately 200 meters (656 feet) away. At Time = 0 seconds, the LEAP will acquire the artificial target, rise to a level of about 3 meters (10 ft), and hover for approximately 7 seconds using its divert thrusters. During this time LEAP will maintain a lock on the artificial target. At the end of this period, the LEAP will drop to a safety net suspended below it, ending the test.

The LEAP projectile has bi-propellant thrusters that utilize a liquid oxidizer and fuel (nitrogen tetroxide and monomethylhydrazine). The carts for handling oxidizer and fuel will be supplied by the test facility. The test facility has the necessary permits to use the various fuels and substances needed for the LEAP hover test (Phillips, 1990). LEAP hover test activities at Phillips are covered by existing environmental documentation (Phillips, 1990). The necessary permits and exemptions have been obtained for the strapdown test from the Kern County Air Pollution Control District (Paxson, 17 December 1990 in Section 4 of this report).

Rocketdyne Division of Rockwell International, Canoga Park, California, is participating in activities at Phillips, and is responsible for the design, fabrication, assembly, and integration of the first LEAP Test Program flight. Rocketdyne's activities will occur at Test Area 125 at Phillips. Currently employed Rocketdyne personnel will be involved in the LEAP Test Program activities. Rocketdyne and Phillips have all applicable Federal, state, and local permits and authorizations necessary for current operations (Phillips, 1990).

1.2.4 Preflight and Flight Test Activities

LEAP target launch preflight activities will include transporting various vehicle components, fuels, and testing equipment to the launch site. Inspection of the various components of the LEAP vehicle, assembly, and fueling operations will take place at the launch pad. Flight test activities begin at the completion of final checkout at the launch pad when the launch vehicle is turned over to launch personnel. Flight test activities include the launch, monitoring, and control of the vehicle during flight, flight safety, and retrieval of data from the flight. Preflight and flight test activities will take place at two major U.S. Government test ranges (WSMR and USAKA) and at a U.S. Government installation that has the necessary facilities (Wake Island Airfield) but is not currently staffed for rocket launches. This section outlines the details of these activities.

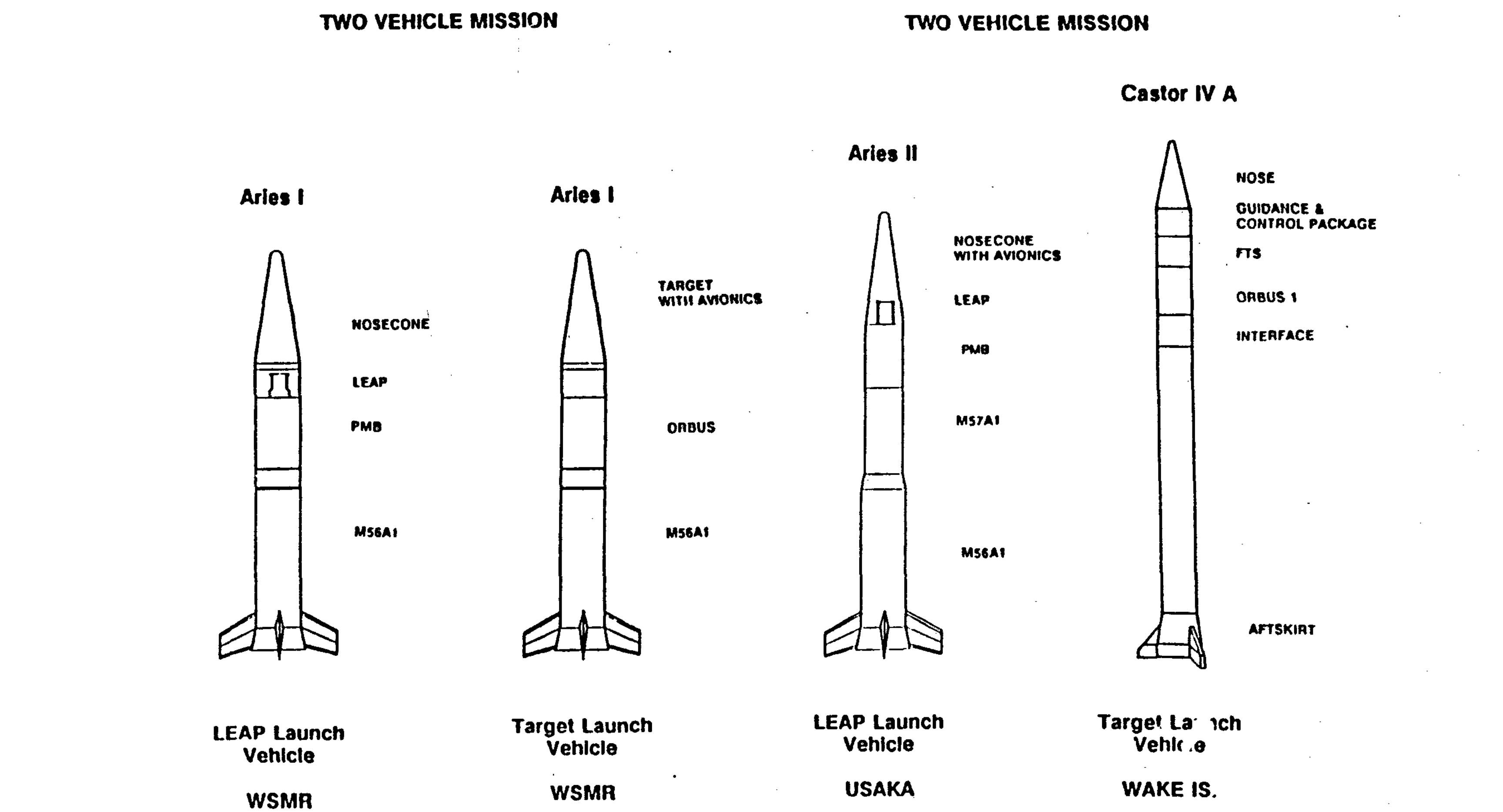
1.2.4.1 Flight Profiles

Currently, three types of flight experiments are planned for the LEAP Program. These include:

1) Mission Operations Checkout Flight (MOCF);
2) Single Rocket Launch with LEAP projectile and Target;
3) Two Rocket Launch with LEAP projectile and Target in Separate Launch Vehicles.

All three types of experiments will occur at WSMR using Aries rocket boosters. Three of the experiments will use a single stage solid fuel booster (the Checkout Flight and the Single Rocket Launch with PMB and target). A fourth experiment will be a two-rocket launch with PMB and target in separate launch vehicles. Both types of LEAP flight vehicles can be seen in Figure 6.

In addition to these flights, two LEAP flights will occur at USAKA. Both flights will be two-rocket launches with the LEAP projectile and target in separate launch vehicles. The



LEAP ENVIRONMENTAL ASSESSMENT | LEAP FLIGHT VEHICLES

Figure 6

LEAP projectiles will be launched from USAKA. Two target vehicles will be launched from Wake Island. All Wake Island target launches will use a Castor IV rocket configuration (Figure 6).

LEAP vehicles at WSMR will be launched into a non-orbital trajectory by Aries boosters. All debris from the LEAP experiments is anticipated to land in the dispersion areas identified for the individual test flights. These dispersion areas are identified in Figures 7A - 7D. Debris dispersion areas for the USAKA flights are illustrated in Figure 8.

The following discussion presents more detailed descriptions of the three types of flight profiles associated with the LEAP Program and support operations which include ground tests, preflight and flight activities.

Mission Operations Checkout Flight - WSMR

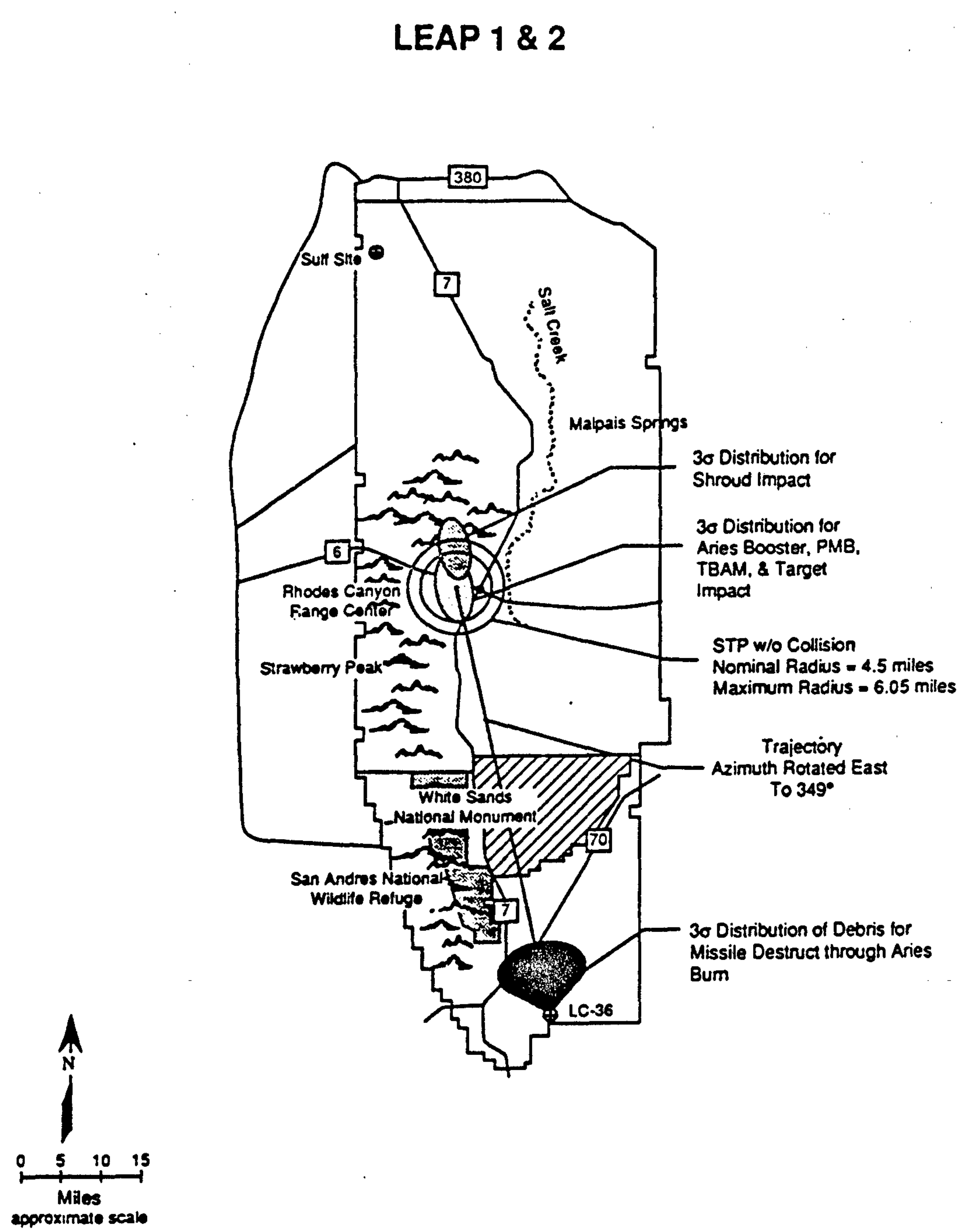
The first flight profile is a mission operations checkout flight (MOCF), without LEAP hardware, to be launched from LC 36 at WSMR. Personnel requirements include approximately 25 persons for both preflight and flight activities for approximately 35 days.

The MOCF launch vehicle is shown as Vehicle 1 in Figure 6. Its five major assemblies are:

1) an M56A1 solid-fuel rocket motor with attached interstage section;
2) a PMB;
3) a Target Boost Assist Module (TBAM);
4) a Free Flyer Observation Vehicle (a LEAP surrogate);and,
5) a Cold-body Target within a nose cone.

The PMB contains the free flyer, telemetry units, TV camera, and general support equipment. The PMB separates from the booster after reaching the exoatmospheric region.

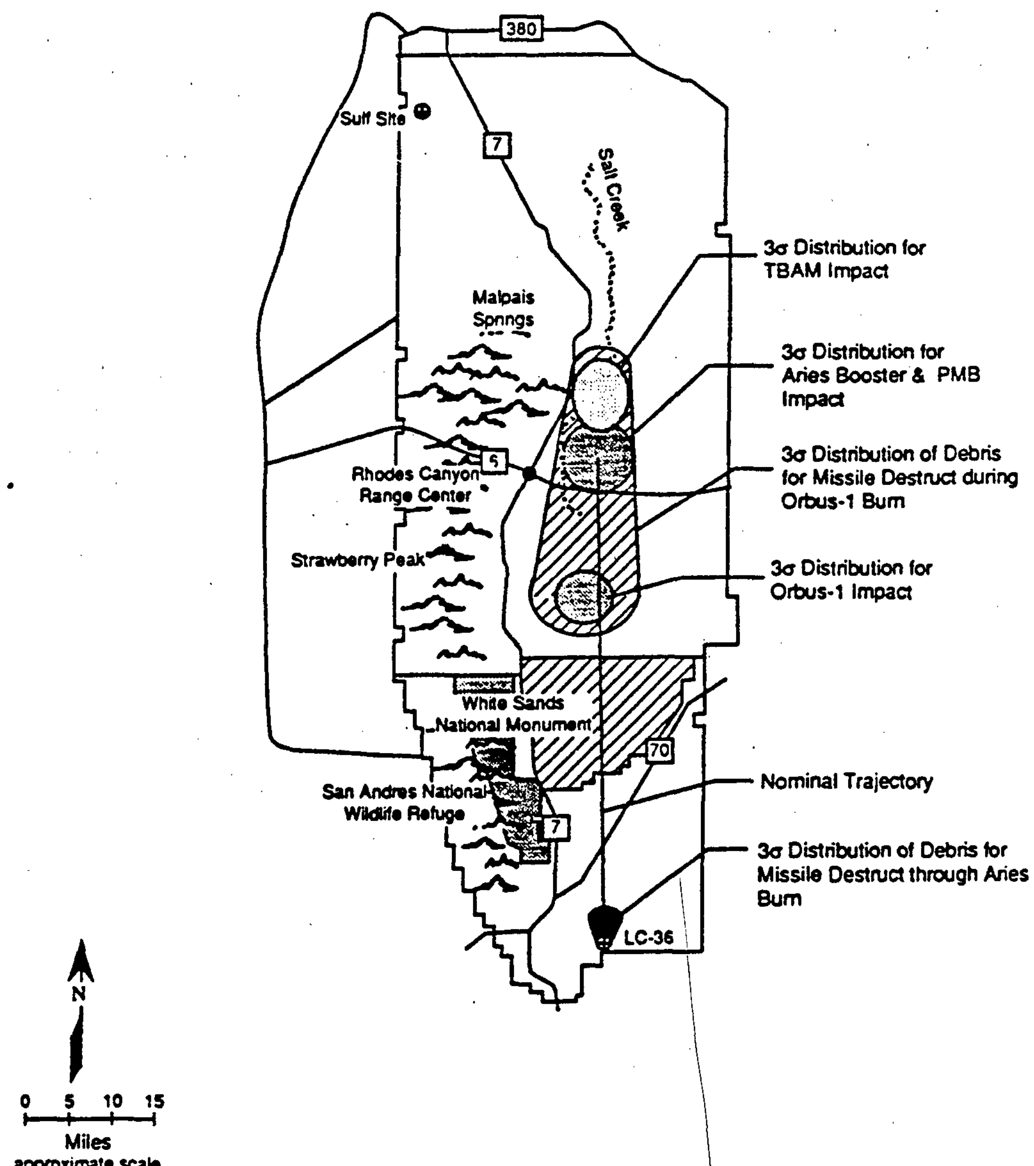
The target, mounted to the top of the PMB, separates from the PMB at an altitude above 100 kilometers (km) (62 miles). The target vehicle contains a cold-gas nitrogen (GN_2)



LEAP ENVIRONMENTAL ASSESSMENT	**LEAP DISPERSION AREAS WSMR**

Figure 7A

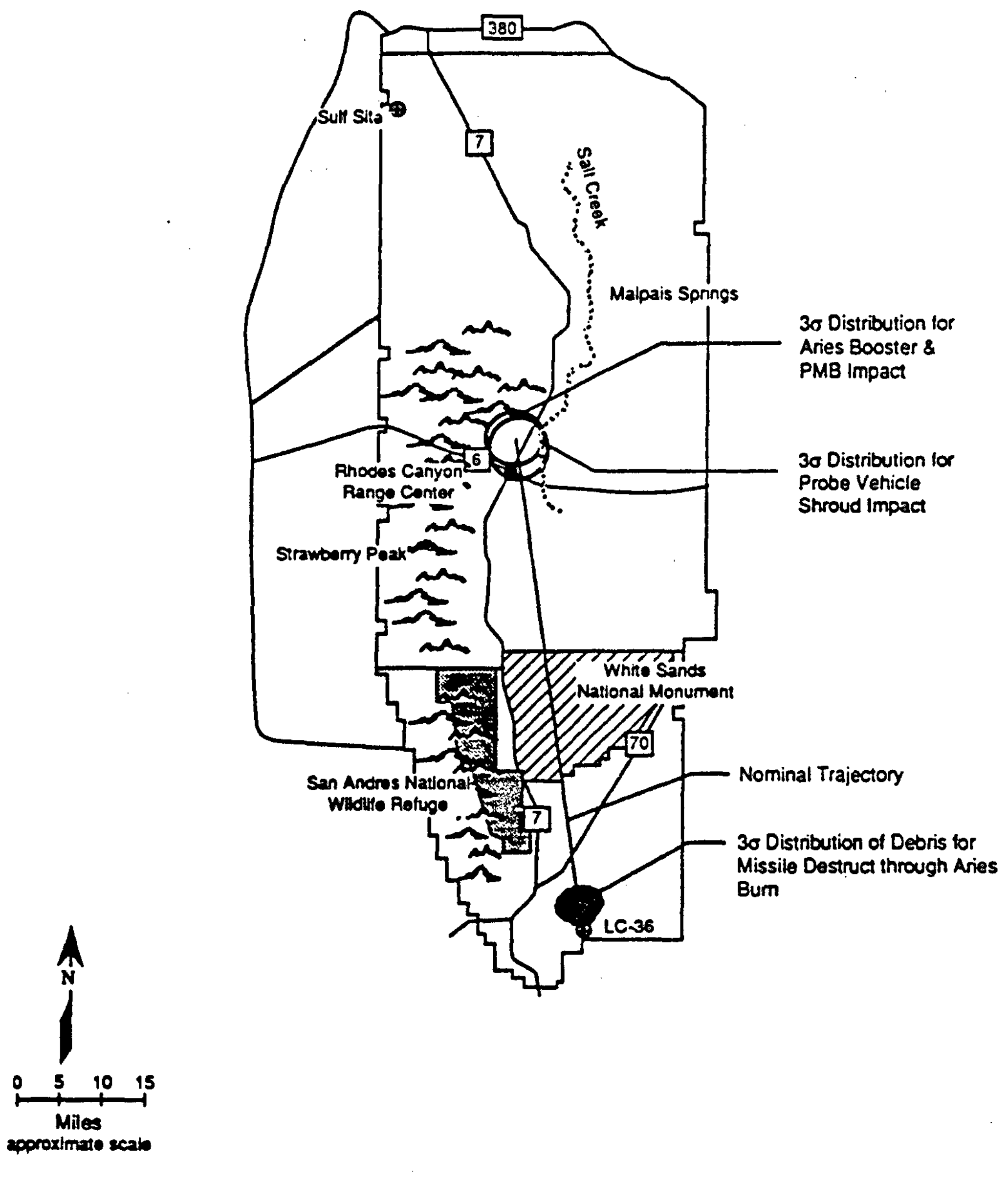
LEAP 3



LEAP ENVIRONMENTAL ASSESSMENT	LEAP DISPERSION AREAS WSMR

Figure 7B

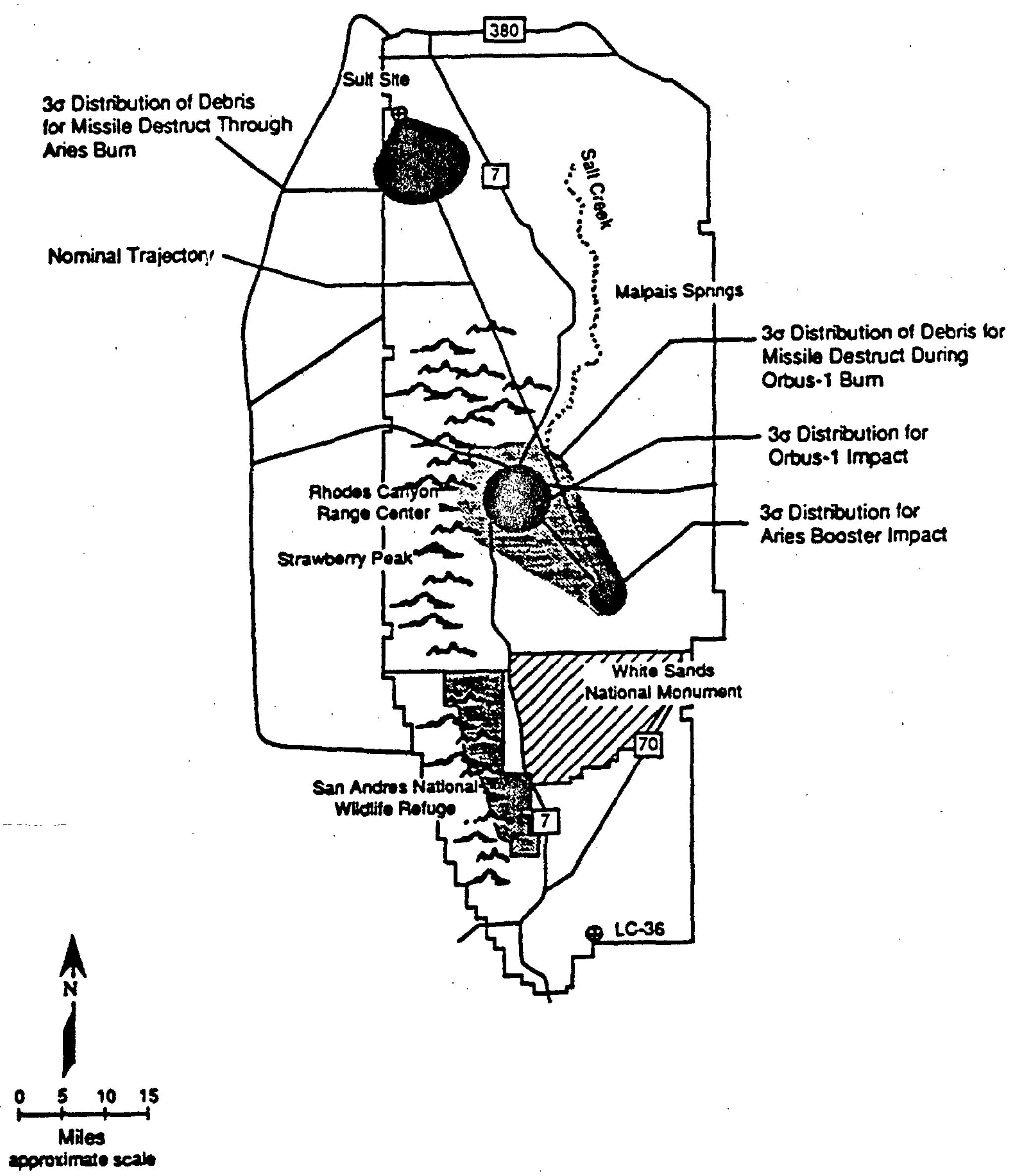
LEAP 4 PROBE LAUNCH VEHICLE



LEAP ENVIRONMENTAL ASSESSMENT	LEAP DISPERSION AREAS WSMR

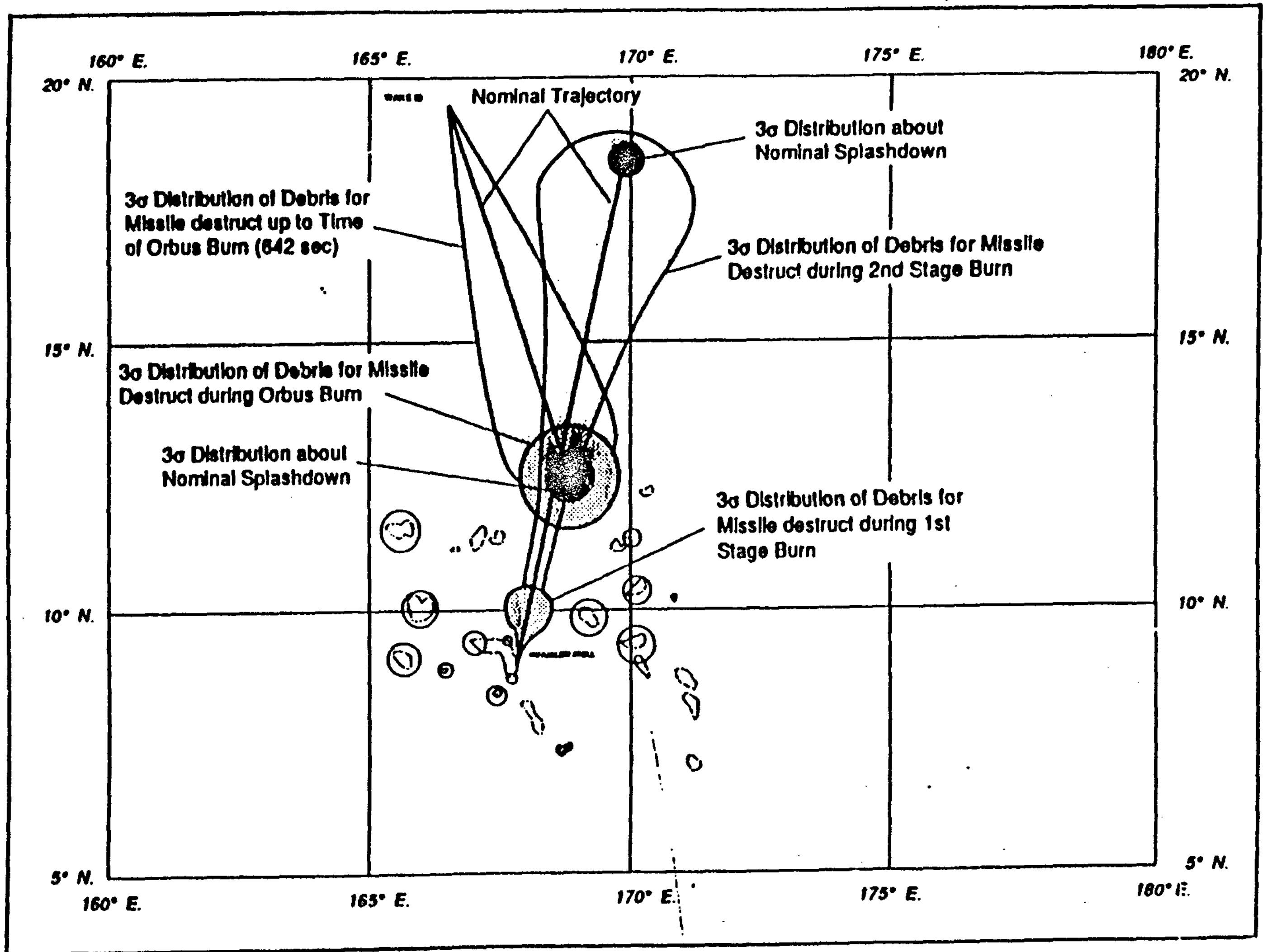
Figure 7C

LEAP 4 TARGET LAUNCH VEHICLE



LEAP ENVIRONMENTAL ASSESSMENT	LEAP DISPERSION AREAS WSMR

Figure 7D



LEAP ENVIRONMENTAL ASSESSMENT	LEAP DISPERSION AREAS USAKA/WAKE ISLAND

Figure 8

attitude control-subsystem (ACS), a fast-burn solid rocket motor, a complete guidance package and a telemetry unit.

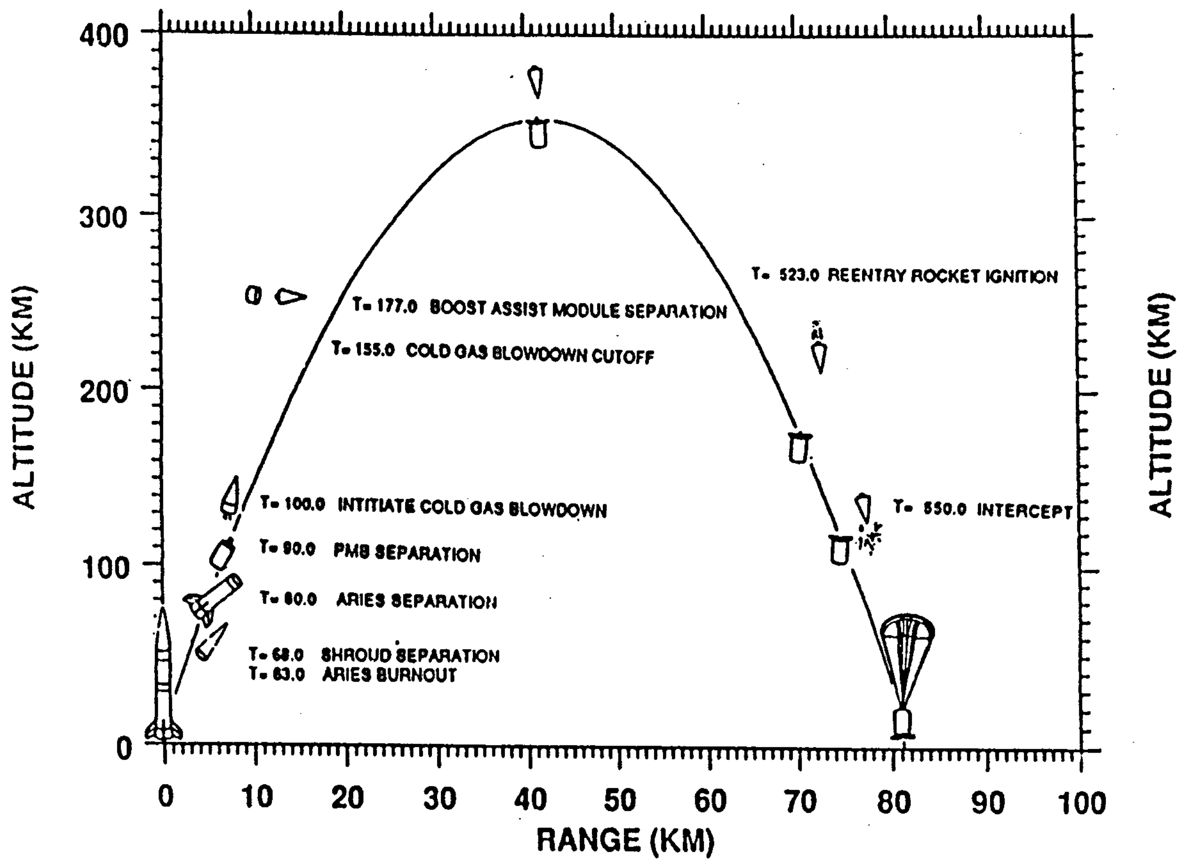
The flight profile for the MOCF is similar to that of the single rocket launch with PMB which is shown in Figure 9. The Free Flyer vehicle consists of a liquid propulsion system, using a maximum of 833 grams of nitrogen tetroxide (N_2O_4), a maximum of 504 grams of hydrazine (N_2H_4) and monomethylhydrazine (MMH), and a visible-light sensor.

The target reaches an apogee of approximately 364 km (226 miles) with apogee for the PMB at 354 km (220 miles). Thereupon, the target stabilizes for reentry and firing of the target's motor. When it reaches a re-entry altitude of approximately 195 km (121 miles), the target reentry rocket is fired. Upon burnout, and at a distance of 12 km (7 miles) between the target and the PMB, the Free Flyer is deployed from the PMB, and attempts to intercept the target. The PMB will be recovered by parachute. All debris from the experiment is expected to fall within the dispersion area illustrated in Figure 7A.

Single Rocket Launch with LEAP projectile and Target - WSMR

Two flight tests will be conducted in this test mode. In each test a single vehicle is used to launch the LEAP projectile, and target; and in each test a PMB/projectile combination and a target are placed in separate sub-orbital trajectories (Figure 9). Flight test objectives are to demonstrate the infrared seeker and guidance and control system capability to divert a Space Test Projectile (STP) to intercept a cold body target. Technological evaluation centers on the performance of the STP's Medium Wave Infrared (MWIR) sensor-seeker, its guidance and control system, and the STP's liquid bi-propellant maneuvering system. The launch vehicle for the single rocket launch flight test mode consists of the following major assemblies:

1) an M56A1 solid-fuel rocket motor with attached interstage section;
2) a PMB;
3) a LEAP projectile;



LEAP ENVIRONMENTAL ASSESSMENT	SINGLE ROCKET LAUNCH MISSION PROFILE

Figure 9

4) a target subassembly within a nose cone;

5) a target boost assist module (TBAM) using either a cold gas blowdown or a Star 13C kick motor; and,

6) a target reentry motor (Orbus-1 rocket motor or Viper V meteorological rocket motor).

Launch vehicle guidance is performed by an inertial navigation system. Both PMB and target are equipped with a cold gas attitude control system. The auxiliary equipment provides an external source of electrical power to the projectile plus cryogenic cooling (LN_2) of projectile sensors until the projectile is ejected from the PMB.

The first flight test of the single launch-vehicle mode involves the Army LEAP. Upon completion of the launch, climb, booster burnout, and target shroud release sequence, the PMB separates from the booster and deploys its target (see Figure 9). Upon separation, the target's axial cold-gas blowdown propulsion system takes it to a higher apogee than the PMB. The PMB tracks the target while maintaining a target oriented alignment.

The target containing the Viper V rocket motor, will be fired downward to achieve an 800 meters per second (m/s) closing velocity with the LEAP projectile. At a range of about 12 km (7 miles) from the target the LEAP projectile is discharged from the PMB (this occurs after target motor burnout). The LEAP projectile then maneuvers into the target's projected flight path, and impacts the target. Propulsion for the lateral divert maneuver of the STP comes from a burn of a small quantity of liquid oxidizer (nitrogen tetroxide, N_2O_4) and fuel (hydrazine, N_2H_4) a maximum of 833 grams of N_2O_4, and a maximum of 504 grams of N_2H_4 or MMH. Upon LEAP impact with the target, both are destroyed; however, the PMB and its instrumentation are recovered by parachute. All debris from the experiment is projected to fall within the dispersion area illustrated in Figure 7A.

A second flight test in this mode (single launch vehicle) involves an experimental intercept with the same parameters as the first flight except as described below. The launch vehicle will place an Air Force developed LEAP in position to begin intercept maneuvers, and also

place the target on a preprogrammed flight path. The PMB and projectile will be launched into sub-orbital trajectories.

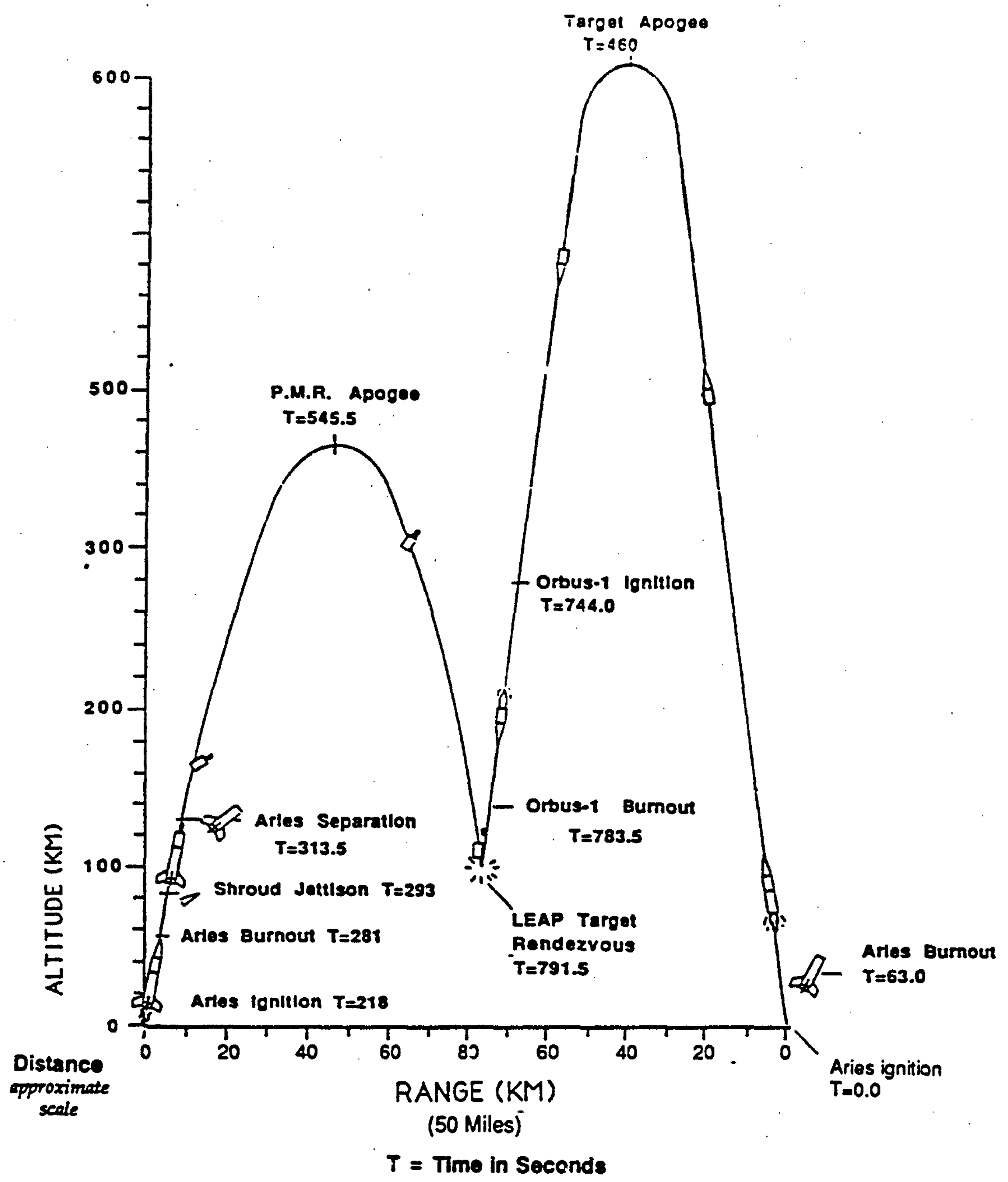
After PMB separation from the booster, the target's Star 13C kick motor will drive the target vehicle to a higher trajectory. When sufficiently downrange, the nose cone shroud is jettisoned and the Orbus-1 target motor is fired to drive the target vehicle to intersect the PMB trajectory. The projectile will be ejected from the PMB and maneuver laterally towards the target's projected flight path to intercept the target (Figure 9). Propulsion for divert maneuvers of the projectile comes from a burn of the small quantity of liquid fuel. All debris from the experiment is expected to fall within the dispersion area illustrated in Figure 7B.

Two Rocket Launch with PMB and Target in Separate Launch Vehicles - WSMR

The objectives of the flight test will be similar to those of the single rocket launch experiment in that it will track, intercept, and impact a target. However, implementation of the mission will be different because two launch vehicles are involved. One vehicle is used to place the LEAP projectile in position to begin intercept maneuvers; the other vehicle will place the target on its trajectory (Figure 6). Both vehicles will be launched from WSMR to provide the target and projectile rendezvous. The LEAP/PMB vehicle will be launched from LC 36 and the Target Vehicle from the Sulf Site launch facility (Figure 2). The two rocket launch profile is illustrated in Figure 10.

For the two rocket launch tests, four major assemblies make up the LEAP/PMB launch vehicle that will be used at WSMR:

1) an M56A1 solid-fuel rocket motor;
2) a PMB;
3) a LEAP projectile; and,
4) a nose cone.



LEAP ENVIRONMENTAL ASSESSMENT	TWO ROCKET LAUNCH MISSION PROFILE - WSMR

Figure 10

Three major assemblies make up the two rocket launch target vehicle that will be used at WSMR:

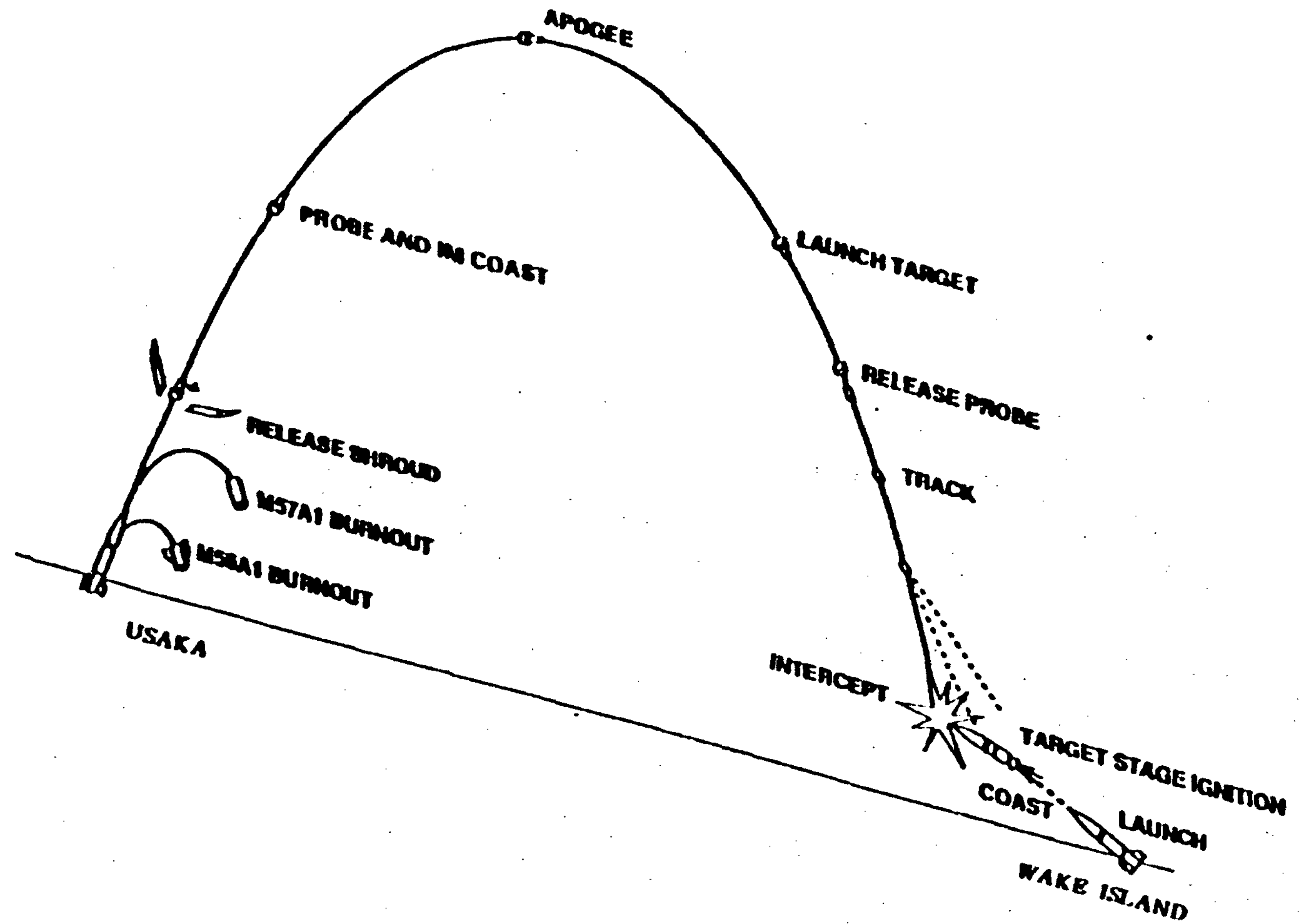
1) an M56A1 solid-fuel rocket motor;
2) a target stage powered by an Orbus-1 motor to accelerate target reentry; and,
3) a conical shaped target containing avionics.

The PMB containing the LEAP projectile will be launched from LC 36 into a sub-orbital trajectory by a single launch vehicle. Booster guidance is by an inertial unit. The PMB will separate from the booster after motor burnout and shroud release. The PMB will continue its trajectory past apogee, falling towards a target position. As the PMB acquires and tracks the target, GN_2 ACS, installed in the PMB, maintains pointing at the target.

Approximately 151 seconds after the target vehicle is launched from the Sulf Site, the Aries booster carrying the LEAP is launched from LC 36. After reaching apogee, the target's Orbus-1 motor will be fired. Approximately 142 seconds later, the STP will maneuver towards the target's projected flight path for target intercept. As in the single rocket launch experiment, propulsion for the lateral divert maneuver of the LEAP projectile comes from a burn of a small quantity of liquid propellants, (a maximum of 833 grams of N_2O_4 and a maximum of 504 grams N_2H_4). Both target and STP will be destroyed at intercept; however, the PMB and instrumentation will be recovered by parachute. Debris from the launches is projected to fall within the dispersion areas illustrated in Figures 7C and 7D.

<u>Two Rocket Launch with PMB and Target in Separate Launch Vehicles - USAKA and Wake Island</u>

Two launch vehicles, each launched from a different test site, are involved in this test profile. The LEAP launch vehicles will be launched from facilities at Meck Island in USAKA. The target vehicles will be launched from Wake Island, which is about 700 miles north of USAKA. Figure 11 shows a typical flight profile for this scenario.



LEAP ENVIRONMENTAL ASSESSMENT

TWO ROCKET LAUNCH
MISSION PROFILE
USAKA/WAKE

Figure 11

The LEAP launch vehicle to be launched from Meck Island will be an Aries II (see Figure 6). The Aries II consists of major assemblies which include:

1) an M56A1 solid-fuel rocket motor;
2) an M57A1 rocket motor;
3) a PMB;
4) a LEAP projectile; and,
5) a nose cone containing avionics.

The LEAP target vehicles to be launched from Wake Island can be seen in Figure 6. The major assemblies of the rocket include:

1) a Castor IVA rocket motor;
2) a flight termination system (FTS);
3) an Orbus 1 motor;
4) a guidance and control package; and,
5) a nose cone.

The Castor IVA solid propellant rocket motor is an improved performance version of the Castor IV motors used as strap-on boosters for the Delta launch vehicle. An earlier version of the Castor IV was used as the first stage in the Athena-H program which was also launched from Wake Island in the early 1970s.

1.2.4.2 Disassembly and Transportation

WSMR and USAKA Launch Vehicles

For the LEAP flights, five M56A1 motors, two Viper V rocket motors, two Orbus-1 motors, and one Star 13C kick motor (all using solid propellant) will be transported from government contractor facilities to WSMR. Approximately 5 liters of liquid hydrazine (N_2H_4) and 5 liters of monomethylhydrazine (MMH), both hypergolic liquids, will be

transported from the National Aeronautics and Space Administration (NASA) White Sands Test Facility (WSTF) in a WSTF government truck to WSMR (a distance of approximately 15 miles) in approved U.S. Department of Transportation (DOT) DOT 3A1800 stainless steel cylinders for the LEAP launches. The cylinders do not require open loop transfer of the fuels at WSMR. Each flight will use a maximum of 504 grams (1.119 lbs) of N_2H_4 or MMH.

N_2O_4 oxidizer (nitrogen tetroxide) will be transferred from the NASA-WSTF to WSMR for these same launches in DOT 3A1800 cylinders also. Of this amount, a maximum of 833 grams (1.836 lbs) will be used. The oxidizer will be shipped separately from the hydrazine in a WSTF government truck with appropriate placarding per DOT regulations as identified in 49CFR178 and Bureau of Explosives Manual 6000. In addition, all other LEAP related components, such as the PMBs, STPs, LAEs, tools, test equipment, etc. will be shipped by truck to WSMR to support the flights (NASA WSTF, June 1991).

For the USAKA rocket launch missions, the rocket motors will be transported by military aircraft from the continental United States to USAKA. After arrival at Kwajalein Island, the motors will be transported by barge to Meck Island where the launches will take place.

For the launches at USAKA, the fuel will originate at Kelly AFB in San Antonio, Texas. The shipping process will be managed by Phillips Laboratory at Edward AFB. MMH, Hydrazine, and N_2O_4 will be shipped in 2.5 gallon stainless steel bottles (trade name HOKE) procured by Phillips Laboratory. The empty containers will be shipped to Kelly AFB in San Antonio, Texas where they will be filled with the appropriate fluid. The full containers will then be shipped by Kelly AFB to Edwards AFB in California under the DOT and BOE regulations previously identified.

Edwards AFB transportation will deliver the full containers to the point of departure for trans-ocean shipping, where USAKA support personnel will take control of the vessels. The fuels will be transferred to a barge or other approved oceangoing vessel, where they will be shipped to USAKA in accordance with BOE Manual 6000.

Once the fluids reach USAKA, a Phillips Laboratory representative will direct movement of the containers from Kwajalein Island to Meck Island. The fuels will be offloaded at the Kwajalein Island dock. They will be immediately placed upon a LCU and sent to Meck Island. There will be no interim storage on Kwajalein Island. Fuel and oxidizers will be transferred to Meck Island on separate vessels. Two LCUs will be used so that there will be no need to have the oxidizer waiting for shipment while the fuel is sent to Meck Island. Handling of the containers will be conducted by USAKA launch personnel. Once the containers have been placed in their respective storage areas, responsibility for the fluids will be assumed by the LEAP project team on the island. Currently, the storage facilities on Meck are approved by the Explosive Safety Board for volumes of 40 gallons for hydrazine/MMH and 20 gallons for Nitrogen Tetroxide.

Removal of the residual propellants to the United States will be the reverse of the above-described operation. Excess fuel and oxidizer will be shipped separately from Meck Island to Kwajalein Island via a LCU where they will be transferred to a barge for shipment to Kelly AFB via Edwards AFB.

Wake Island Launch Vehicles

Castor IVA and Orbus 1 motors will be shipped by commercial truck from Thiokol, Inc. in Huntsville, Alabama to Travis AFB, California where they will be transported by military aircraft to Wake Island. Additionally, all other LEAP components, expendables, tools, test equipment, etc., will be shipped from the continental U.S. to Wake Island by air and barge.

All materials containing solid propellant or flight ordnance will be shipped in accordance with Bureau of Explosives Tariff No. BOE-6000-1, Air Force Manuals 127-100 and 161-30, and other applicable DoD and U.S. Department of Transportation (DOT) regulations.

1.2.4.3 Assembly and Checkout

WSMR and USAKA Launch Vehicles

The launch vehicles, described in Section 1.2.5.1, are assembled and receive a check-out prior to launch. Tests of components and assemblies involve: 1) receiving, inspecting, and verifying the boosters, PMB, and LEAP hardware upon arrival at the launch location; 2) integrating, fueling, and assembling the LEAP hardware into the PMB; 3) evaluating the launch support equipment (equipment installation and checkout, calibration, and maintenance) and prelaunch data reception at a Launch Control Blockhouse; and 4) assembling the PMB, interstage, target, and boosters on the launch pad. These component/assembly tests will be conducted at existing MAB's (Building N-220 at LC 36 and the LC 36 launch pad for WSMR flights and either Building 5080 or 5098 on Meck Island for the USAKA launches). Approximately 10 additional contractor personnel will be required for these component/assembly tests, over a period of 45 days.

The LEAP projectiles are fueled with the hypergolic liquid propellant approximately 16 days before launch by NASA and Phillips personnel who routinely perform such operations and are fully qualified for safe operations. The LEAP projectiles are designed to allow LEAP personnel to work on the launch vehicles while the projectiles are fueled.

Launch pad activities for each flight will include final assembly of the missile, attachment to the launcher and launch of the rocket in support of the LEAP Program. The liquid fuel and oxidizer will be transferred to mobile fuel carts at the storage areas. The fuel carts contain all necessary storage, liquid transfer, and safety systems for transporting the liquid propellant. The fuel carts consist of on board pressurization (helium or nitrogen), a propellant scale, manifold and valve used to regulate flow, and stainless steel propellant transfer tank. The cart works in conjunction with a propellant decontamination and neutralization system that consists of water and sodium hydroxide to dilute the propellants. Liquid fueling will be accomplished in accordance with Occupation Safety and Health Administration (OSHA) guidelines for handling hazardous and toxic materials, and in

accordance with Safety Standing Operating Procedures (SSOP) developed for the handling of hydrazine, monomethylhydrazine, and nitrogen tetroxide at host installations and approved by the installation Ground Safety Officer. The Safety Procedures establish responsibility for safety standards and requirements. Video surveillance and voice communication will be maintained with the Launch Operations Control Center (LOCC) throughout the fueling operation. Overall responsibility for launch pad operations resides with the installation ground safety officer, with specific responsibility for liquid propellant handling delegated to Phillips Laboratory under the direction of the host installation. Phillips Laboratory has developed Propellant Transfer Operations Procedures currently in use for the handling of the liquid bipropellants (Procedure Nos: 14697-TOP-460 and 14697-TOP-360) that will be used for the propellant fueling of the LEAP projectiles.

Any spilled fuel will be captured in a drip trap that is an integral part of the fueling cart system. The fuel would then be vacuumed up by the cart, decontaminated, and neutralized. Removal from the installation for proper disposal would occur in accordance with CERCLA and RCRA guidelines.

Wake Island Launch Vehicles

Preflight tests at Wake Island will involve: 1) receiving, inspecting, and verifying the boosters, interstages, and flight support module upon arrival at Wake Island; 2) integrating the launch vehicle stages and payloads; 3) evaluating the launch support equipment (LSE) installation and checkout, calibration, and maintenance, and prelaunch data reception at Wake Island Launch Control Center; and 4) assembling the interstages, flight support module, and other components.

Primary technical staffing to support preflight tests and launch activities at Wake will be provided by temporary assignment of Government and contractor personnel; support staffing will be provided by existing base personnel. While advance personnel will arrive at Wake approximately 105 days before launch, most personnel will arrive about 70 days before launch. Most temporary personnel are expected to depart Wake within 14 days after

launch. From 100 to 125 additional personnel will be required to support the LEAP program target launches.

1.2.4.4 Launch and Range Control

WSMR and USAKA Launches

Existing Naval Ordnance Missile Test Station (NOMTS) facilities will be used to support the flight testing for LEAP launches at WSMR. NOMTS, the project sponsor at WSMR will provide: 1) program management for installation activities, 2) flight and ground safety requirements, 3) funding to the installation, 4) facilities, launcher, missile assembly, and instrumentation, 5) range coordination and documentation, and 6) conduct the flight tests.

The host installation provides the airspace, instrumentation, data collection/reduction, mission scheduling, test execution and control, flight termination system approach, and flight termination control. For flights originating at WSMR, the blockhouse at LC 36 will be used for the Launch Operation Control Center. Building 300 will be utilized for range control. Similar flights are routinely conducted from LC 36, and similar operations are regularly performed at LC 37 and Building 300. For flights launched from USAKA, the Meck Island Control Building (Building 5050) will be used for launch control. The Range Operations Control Center on Kwajalein will be utilized for range control.

Meck Island at USAKA will be used to support the Kwajalein Atoll based LEAP launches. Launch and support facilities on Meck Island have been previously constructed for the SDI program and would be used in support of the LEAP Program. These include a newly constructed missile assembly building (MAB), launch station, launch equipment room and payload assembly building, and fueling area. Rehabilitated buildings include the Meck Island Control Building (Bldg. 5050) for launch control and technical support, Launch Equipment Room (Bldg. 5070), Payload Assembly Building (Bldg. 5087), Nitrogen Tetroxide Storage Area (Bldg. 5090) and a number of other support structures used for warehousing, maintenance shops, etc. (USASDC, 1989).

Wake Island Launches

Target launches at Wake Island in support of LEAP will utilize existing launch facilities that were constructed for the Starbird program but are not currently in use. Flight test activities begin at the completion of final checkout at the launch pad, when the launch vehicle is turned over to launch personnel, and include the launch, monitoring and control of the vehicle during flight, range safety, and retrieval of data from the flight.

Launch pad activities for each flight will include the final assembly of the missile and attachment to the launcher and launch of the missile. The launch elevation will be 80 to 89 degrees with a 130 to 150-degree azimuth. A representative baseline trajectory is provided in Figure 11.

Overall responsibility for launch pad safety operations resides with the WSMR ground safety officer. Safety personnel develop ground, flight, and range safety plans and submit them to the appropriate safety offices at WSMR well in advance of the actual activities. This information is reviewed by a panel of safety personnel from interested and affected organizations. Through an iterative process, the panel develops the launch criteria for implementation by the WSMR ground and range safety officers. The safety plans, launch hazard areas, and debris analysis results are consistent with the analysis and mitigation measures identified in this document.

1.2.4.5 Ground and Flight Safety

Booster Reliability

Following is a briefing summary of the backgrounds and reliability of the solid rocket motors which will be utilized in the LEAP program.

1. Castor IVA

The Castor IVAs are used as strap-on boosters for the target launch vehicle from Wake Island. One hundred and sixty-two of the motors have been fired (static and flight) with no failures. This number of successful firings yields a reliability of 98.5% at a 90% confidence level. The Caster IVA has been in production since 1988.

2. STAR 13C

The STAR 13C was used as a vernier motor on the Titan missile system. It is no longer in production and, since the retirement of the motors, has been in storage under the cognizance of USAF/BMO. The test history is 119 static firings and 129 flights without failure for a reliability rating of 99.2% at a confidence level of 90%.

3. M56A1

The reliability of the M56A1 motor is classified. However, in 42 launches of the Aries configuration using the M56A1 there have been no failures of the motor.

4. M57A1

The M57A1 served as the third stage of the Minuteman I missile. It was produced during the 1960s. The remaining motors are in controlled storage under the cognizance of USAF/BMO. The Minuteman I missile has been flown over 100 times (operational testing and Reentry Systems Launch Program (RSLP)) with an overall missile reliability greater than 90% (actual reliability is classified).

5. ORBUS I

The Orbus I is a recently developed (1989) motor intended for use as an upper stage and target motor in a number of booster applications. The test history is as follows: four

flightweight motor cases successfully tested, four flightweight nozzle assemblies successfully tested, four flightweight motors test fired, two motors qualification test (temperature, vibration, etc.) fired successfully, two flight motor successes (STARBIRD). Based on the relatively conservative design and the consistency of the test results, United Technologies has assigned a reliability point estimate of 0.994 (99%) to the motor. With the limited number of tests undertaken, the calculated demonstrated reliability is 82% at a confidence level of 80%, this is an extremely good number given that the motor is new.

6. VIPER-V

The VIPER-V motor is the newest in the long series of conservatively designed VIPER sounding rocket motors. Although similar to the earlier qualified versions, a switch to a different qualified propellant and a new liner will necessitate requalification of the motor. Two qualification firings are planned prior to the first LEAP flight. No reliability value can be assigned at the present time. Based on the past history of the VIPER family of motors, the reliability should be well above 90%.

WSMR and USAKA Launches

Flight safety is under the jurisdiction of the host installation and flight testing will not proceed if safety requirements are not met by flight vehicle design and construction. Safety parameters have been met for previous high altitude rocket launches using Aries boosters from the launch pads. For WSMR flights, safety requirements are defined by memorandum from the Operations Control Division, WSMR (NRO, 1990). These requirements cover: 1) the rocket motor system, 2) Target Vehicle, 3) Payload Module Bus, and 4) Space Test Projectile. The LEAP vehicle incorporates equipment, such as a flight termination system, to meet these requirements. Similar requirements are being defined that would apply to follow-on flight tests. Subsequent launches at USAKA require similar coordination with installation safety personnel resulting in a flight safety plan and other support range documentation (DOA, 1989).

For WSMR launches, LEAP safety personnel develop a Missile Flight Safety Operations Plan (MFSOP) in accordance with the WSMR Range Users Handbook 1990, Chapter 12 (Missile Flight Safety) and WSMR Regulation 385-17 (Flight Safety).

The flight safety plan consists of five principal elements (National Range Operations, WSMR Missile Flight Safety Operational Plan - Aries, 20 September 1988 NRO, 1988). The first, Administrative Information, identifies the test/mission, key personnel, control site, mission support, and associated support planning. The second element, Vehicle and Payload System Information identifies the vehicle and payloads to be used in the flight. Flight Termination System, the third element, describes the termination method and verification procedures/restraints. The fourth element, Test Operational Concepts, identifies the flight, test events, (e.g. communication verification), test limits (e.g. launch angle), and operating limits (when the rocket would be destroyed). The fifth element, Range Derived Requirements, identifies requirements for roadblocks and evacuation, tracking sites, command destruct links, and other requirements such as post launch data requirements.

As previously stated, LEAP flights at WSMR will be launched from LC-36. The entire range and western extension (Figure 2) will be evacuated for all LEAP flights. This plan creates an evacuation zone of about 100 miles south to north by 52 miles east to west. This plan assures compliance with the following WSMR requirements:

1. The risk of any part of the experiment hitting a non-participant must be less than 10^{-6}.
2. The risk for impacting mission essential personnel is 1×10^{-5}.
3. The risk for hitting government property on range is 1×10^{-3}.

The target launch for the fourth LEAP launch, which is launched from the Sulf Site, uses the same evacuation area as launches from LC-36. An Aries booster was launched from the Sulf Site for the EXCEDE program using these parameters.

Flight safety planning is an iterative process that is conducted throughout the period prior to the launch. For the LEAP program, this has resulted in modifications to the launch azimuth in order to increase safety parameters, resulting in the debris dispersion areas previously presented. The process has been coordinated with a panel of safety personnel from interested and affected organizations. The final plan is submitted well in advance of actual test activities.

The safety panel ensures that the flight plans meet range safety requirements and calculates the predicted flight path using reasonably foreseeable adverse wind conditions to establish the limits of the vehicle dispersion pattern. The panel uses reasonably foreseeable performance anomalies to predict the flight hazard and dispersion areas. As the designated safety official at the launch site, the range safety officer allows launch of the vehicle only when he is satisfied that all safety parameters have been met.

WSMR Range Operations monitors the trajectory from the ground in all tests. Flight safety is maintained through tracking and up-link command circuits which can terminate flights if necessary.

Flight safety planning at USAKA has been identified in the USAKA EIS. The elements identified and evaluated in the flight safety plans for USAKA include individual and property risk in the proposed flight path, safety support system requirements, trajectory and debris footprint calculations, range clearance requirements, and identification of the flight termination system (USASDC, 1989a).

Explosives Classification Each solid propellant booster contains chemicals that are categorized as explosive ordnance. The net explosive weight (NEW) of each booster is calculated to convert different hazard classes to a single class weight to determine appropriate explosive quantity safety distances. The motors to be used include the M56A1 (10,370 pounds of Class 1.3 solid propellant), M57A1 (3,657 pounds of Class 1.1 solid propellant), and Orbus 1 (912 pounds of Class 1.3 solid propellant). The explosive quantity safety distance for the LEAP launch pad is an area with a radius of 1250 feet (380 meters),

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launches normally last less than a few minutes, no single area will be subjected to noise levels above the stated criteria (SDIO, 1990).

Wake Island Launches

LEAP safety personnel develop ground, flight, and range safety plans and submit them to the appropriate safety offices at WSMR well in advance of the actual activities. This information will be reviewed by a panel of safety personnel from interested and affected organizations (TBE, 1990). Through an iterative process, the panel develops the launch criteria for implementation by the WSMR ground and range safety officers. The safety plans, launch hazard areas, and debris analysis results are consistent with the analysis and mitigation measures identified in this document. The safety planning process follows the process as identified for WSMR launches.

The evacuation area for the Wake Island launches ensures compliance with the three WSMR requirements previously identified. The evacuation area required to meet these requirements does not necessitate evacuation from any islands. A safety keepout zone has been established to prevent aircraft from entering the evacuation area during launch activities from USAKA and Wake Island. The evacuation area runs roughly concurrent with the debris dispersion area illustrated in Figure 8. The zone is approximately 600 miles long and 300 miles wide covering an area between USAKA and Wake Island. Launch personnel remain in secure bunkers during launch activities and nonessential personnel leave Meck Island.

The safety panel ensures that the flight plans meet range safety requirements and calculates the predicted flight path using reasonably foreseeable adverse wind conditions to establish the limits of the vehicle dispersion pattern. The panel also uses reasonably foreseeable performance anomalies to predict the flight hazard and dispersion areas. As the designated safety official at the launch site, the range safety officer will launch the vehicle only when he is satisfied that critical safety parameters have been met.

1.2.5 Recovery and Decommissioning

1.2.5.1 WSMR and USAKA Launches

Recovery operations will only occur at WSMR. The LEAP and remaining debris from the USAKA launches will fall into the ocean eliminating the possibility of debris recovery. WSMR recovery operations will be in accordance with installation requirements (WSMR, 1989).

LEAP launch and support facilities will not be decommissioned as they are utilized for ongoing DoD and civilian launch activities.

1.2.5.2 Wake Island Launches

Following the completion of the LEAP activities at Wake Island, communications, launch control, and other types of equipment that do not support the permanent mission of the Wake Island airfield will be removed. Launch towers and other launch-specific above ground structures constructed for LEAP will be removed to ground level, and the site will be permitted to return to its former condition.

1.2.6 Program Mitigations

The potential for significant impacts to the various environmental media at LEAP test locations is remote. Probability analyses and safety and debris recovery procedures cited in this document demonstrate the unlikelihood of impacts to sensitive environmental resources. Routine operations procedures at WSMR, USAKA and Wake Island have been incorporated into the LEAP Test Program as mitigations in the unlikely event that these resources are affected.

1.2.6.1 WSMR

The following mitigation is designed to protect the Todsen's pennyroyal (Federal Endangered) and its habitat.

1. To minimize damage from brush fires, an airplane will be on stand-by to deliver an aerial-drop of a fire extinguishing slurry to the potential pennyroyal habitat, if a fire is reported. All fire protection activities in the potential suitable habitat will be coordinated with the Chief, Environmental and Natural Resources Division.

2. Upon receipt of information or discovery that debris landed within 400 meters of the potential habitat area, recovery personnel will immediately notify the Chief, Range Support Section. No recovery operation will be undertaken in the potential habitat area without the concurrence of the Chief, Range Support Section, Research Rockets Director NOMTS, and the Chief, Environmental and Natural Resources Division.

3. No vehicles will enter within 400 meters of potential habitat unless the Officer in Charge (OIC) or Noncommissioned Officer in Charge (NCOIC) of the recovery team has personally coordinated the matter with the Environmental Chief or his authorized representative.

4. All recovery operations will be coordinated with the Chief, Environmental and Natural Resources Division, on recovering missile debris within 400 meters of potential habitat area.

5. Prior to any excavation of missile debris at potential habitat area or outside the designated impact area, the OIC or NCOIC of the recovery team will contact the Chief, Range Support Section and Chief, Environmental and Natural Resources Division. No excavation will be conducted without an environmental representative present at the site. After the debris removal, all disturbed areas will be restored to

match the surrounding terrain. Such restoration will include the use of native plant species.

6. When necessary to prevent damage to the environment, helicopter recovery of debris will be utilized with recovery vehicles located at the nearest roadway segment. Such helicopter recovery would also be used in instances when debris recovery is necessary in areas not accessible by vehicle.

Salt Creek and Malpais Spring have been determined to be habitat for the New Mexico state endangered White Sands pupfish. The probability analysis in Section 3.3.1.6 demonstrates that there are an estimated 19 chances in 10,000 of any piece of debris from LEAP flights landing in Salt Creek or Malpais Spring. The potential for impacts to Salt Creek is therefore very remote. However, routine measures have been adopted at WSMR to protect the Salt Creek habitat. These measures have been incorporated into the LEAP Program to protect the habitat in the unlikely event that debris impacts in Salt Creek.

1. Upon receipt of information or discovery that an impact occurred within 400 meters of Salt Creek, recovery personnel will immediately notify the Chief, Range Support Section. No recovery operation will be undertaken in the Salt Creek area without the concurrence of the Chief, Range Support Section, Research Rockets Director NOMTS, and the Chief, Environmental and Natural Resources Division.

2. No vehicles will enter within 400 meters of Salt Creek unless the Officer in Charge (OIC) or Noncommissioned Officer in Charge (NCOIC) of the recovery team has personally coordinated the matter with the Environmental Chief or his authorized representative.

3. All recovery operations will be coordinated with the Chief, Environmental and Natural Resources Division, on recovering missile debris within 400 meters of Salt Creek.

4. Prior to any excavation of missile debris at Salt Creek or outside the designated impact area, the OIC or NCOIC of the recovery team will contact the Chief, Range Support Section and Chief, Environmental and Natural Resources Division. No excavation will be conducted without an environmental representative present at the site. After the debris removal, all disturbed areas will be restored to match the surrounding terrain. Such restoration will include the use of native plant species.

The following mitigation is designed to protect cultural resources at WSMR.

1. Upon receipt of information or discovery that an impact occurred outside the designated impact area, the recovery personnel will conduct a survey for any artifacts in the vicinity of the debris. If any artifacts are discovered, they will not be disturbed and the Chief, Range Support Section and Chief, Environmental and Natural Resources Division will be notified.

2. When necessary to prevent damage to the environment, helicopter recovery of debris will be utilized with recovery vehicles located at the nearest roadway segment. Such helicopter recovery would also be used in instances when debris recovery is necessary in areas not accessible by vehicle.

3. Should a cultural resource be uncovered as a result of debris impact, a decision to excavate or cover the material will be made jointly by the WSMR Environmental Office, NOMTS, and SDIO in accordance with the PMOA described in Section 3.3.1.7.

The following mitigation is designed to protect the desert bighorn sheep (state Endangered) and its habitat.

1. No debris recovery will be undertaken near Strawberry Peak, by helicopter or vehicle, when Desert bighorn sheep are in the area.

2. All recovery operations within Desert bighorn sheep habitat will be coordinated with the Refuge Manager, U.S. Fish and Wildlife Service, San Andres National Wildlife Refuge.

1.2.6.2 USAKA

1. All LEAP Test Program Activities will be conducted within the scope of the USAKA Record of Decision (ROD), December 4, 1989, unless otherwise noted within the document.

2. The LEAP Program office will be responsible for the removal of all hazardous materials and wastes generated by the LEAP Test Program.

1.2.6.3 Wake Island

The following mitigation measure will be implemented to minimize adverse impacts to existing wildlife on Wake Island as a result of the location of radar sites.

1. Selection of alternative sites that are environmentally acceptable, (i.e., not located near nesting habitat). The specific sites will be agreed upon between LEAP program officials and the USFWS in response to wildlife activity in the area immediately prior to placement of the portable radar/telemetry equipment.

1.3 NO ACTION

The no-action alternative for LEAP is to not continue the LEAP Program. Additional flights associated with LEAP would not occur at WSMR, USAKA, and Wake Island installations.

1.4 ALTERNATIVES CONSIDERED BUT NOT CARRIED FORWARD

An extensive analysis was conducted to evaluate potential alternatives in support of the LEAP Test Program, including alternatives to the boosters and launch test ranges as described in previous sections. The process included identifying the boosters which met program specifications and identifying those ranges that could support mission requirements (Table 2). All LEAP test flights have been reviewed by the Treaty Compliance Review Group. The group has required that the third, fourth, fifth, and sixth LEAP test flights be flown from either WSMR or USAKA, which are ABM designated ranges. After consideration of the sixteen booster configurations found in Table 3, only the Aries I, Aries II, and the Castor IVA were found to be acceptable. Boosters which were considered but not included in the program are identified in Section 1.4.1. Test ranges which were considered but not included in the program are identified in Section 1.4.2.

1.4.1 Alternative Launch Vehicles

Detailed studies were performed to select the appropriate launch vehicle to support LEAP test flights. Critical factors in the booster selection process included weight, diameter, performance characteristics (including reliability), availability, and compatibility with various test ranges. Boosters considered for the LEAP Test Program are shown in Table 3.

The Black Brant and Aries I boosters were the only two boosters to meet the program requirement of being compatible with launching from WSMR. Both boosters have previously been flown from WSMR. However, the Black Brant booster has a 17 inch diameter, compared to the 48 inch diameter of the Aries. The necessary booster width to accommodate the LEAP payload is designated as 40 inches. The Black Brant, therefore, does not meet program specifications and was dropped from further consideration.

The analysis for booster performance was also applied to LEAP projectile launches from USAKA. For the reasons cited above, the Aries I and Aries II boosters were chosen over other alternatives. A detailed analysis was performed to guide booster selection for the

TABLE 2 - LEAP EXPERIMENT SELECTION OVERVIEW

EXPERIMENT	REQUIREMENTS	RANGE OPTIONS	BOCSTER OPTIONS	RATIONALE FOR TEST SELECTION RANGE/BOOSTER
1	Mission Checkout	WSMR← KMR Wallops Poker Flats	Aries I← BBVc Castor I Talos/M57A1	Cost, Radar Data Collection/Consistency
2	Cold Body Intercept Vc - 1 km/s	WSMR← KMR Wallops Poker Flats	Aries I← BBVc Castor I Sargeant & M57A1 Talos/M57A1	Cost, Radar Data Collection/Availability Guidance Accuracy, WSMR Qualified, Payload Volume
3	Boosting Solid (Orbus) Intercept Vc - 1.5 km/s	WSMR← KMR	Aries I BBVc Castor I Sargeant & M57A1 Talos/M57A1	Cost, ABM Treaty Requirements/Availability Consistency, Guidance Accuracy, WSMR Qualified
4	Cold Body Intercept Vc - 3 Km/s TBM-Type Tgt (Orbus)	WSMR← KMR	Aries I BBVc Castor I Sargeant & M57A1 Aries II Castor II Castor IVA Pegasus (1st Stage) Talos/M57A1	Cost, ABM Treaty Requirements/Availability Guidance Accuracy, WSMR Qualified (Aries I), No 50k Rail at WSMR (for Castor IVA)
5	Boosting Solid (Orbus) Intercept Vc ≥ 5 km/s Test Alas	WSMR← KMR	Aries II← MMI Pegasus (1st Stage) Castor IVA Castor IVB	Large Area, 50k Rail Launcher, ABM Treaty Requirements/Aries II: Range, Velocity, Guidance, Castor IVA; Availability, Range Velocity, Reliability
6	Boosting Solid (Orbus) Intercept Vc ≥ 5 km/s Test Alas	WSMR← KMR	Aries II← MMI Pegasus (1st Stage) Castor IVA Castor IVB	Large Area, 50k Rail Launcher, ABM Treaty Requirements/Aries II: Range, Velocity, Guidance, Castor IVA; Availability, Range Velocity, Reliability

TABLE 3 - SELECTED BOOSTER DATA FOR LEAP STUDIES

Booster(s)	Government Surplus/ Manufacturer	Reserved[1] Total Surplus	Delivery Delay After Order	Weight (lbs)	Diameter (in)	WSMR KMR Qualified	V_{80}[2] (km/s)	Apogee[2] (km)
Alcor I	Surplus	1/4	N/A	1,000	20.5	No	--	--
Antares II	Surplus	0/2	N/A	2,785	30.3	No	--	--
Aries I (M56A1)	Surplus	40/62	N/A	11,400	48.0	Both	3.0	575
Aries II (M56A1 & M57A 1)	Surplus	1/5	N/A	16,900	48/38	KMR	3.6	975
BE 3	Hercules (Sandia Owned)	2/2	N/A	214	19	No	--	--
Black Brant VC	Bristol Aerospace (SDIO Owned)	1/8	1 yr	2,819	17	WSMR	1.8	180
Castor I	Thiokol (Sandia Owned)	N/A	16 mo.	8,746	31	KMR	2.2	300
Castor II	Thiokol	N/A	1 yr.	9,525	31	KMR	2.7	440
Castor IVA	Thiokol	N/A	18 mo.	25,562	40	KMR	3.8	960
Castor IVB	Thiokol	0/13	N/A	4,108	19/38	No	4.1	1040
Sargeant & M57A1	Surplus	N/A	12-14 mo.	22,138	40.1	KMR	2.1	303
Pegasus (2nd Stage)	Hercules	N/A	12-14 mo.	3,632	39.7	No	2.6	440
Pegasus (2nd & 3rd Stages)	Hercules	N/A	12-14 mo.	4,629	40.1	No	2.3	453
Pegasus (1st Stage)	Hercules	N/A	12-14 mo.	14,113	56	No	4.4	1329
Stars (Polaris A3 & Orbus I)	USA/SDC-Owned	13/60	N/A	36,113	44.4	No	N/A	N/A
Talos & M57A1	Surplus	N/A	N/A	5,937	38(31)	KMR	2.1	296

(1) Boosters Committed to other Programs/Total Government Owned as of 27 Mar 1990

(2) V_{80} and apogee are for a trajectory which would impact about 80 km if fired at about 348° azimuth with a 400 kg payload. No entry is made if this payload cannot be lifted 80 km or achieve a $V_{80} \geq 1.5$ km/sec.

LEAP target launches. The Castor IVA booster was chosen, and as such will serve as the target vehicle booster for Wake Island launches.

1.4.2 Alternative Launch Locations

The evaluation criteria for range selection included treaty considerations, facilities, range safety, range area, cost, scheduling, and capability to satisfy mission requirements. A major factor in the first two LEAP test flights is to gather high resolution, accurate radar and telemetry data that can be used to fully characterize the LEAP target vehicle's performance. After a preliminary review of existing test ranges, the analysis was narrowed to include Poker Flats, Wallops Island, White Sands Missile Range, and U.S. Army Kwajalein Atoll (USAKA). As was previously stated, the Treaty Compliance Group has required the third through sixth flights to be flown from WSMR or USAKA. For reasons of minimizing cost and maximizing program coordination, flights one and two were also limited to those two ranges.

For the first four LEAP test flights, WSMR has the capability to support the mission requirements, which includes accommodating closing velocities of up to 2.0 km/sec. The fourth LEAP flight stresses the range area and geometry to the maximum envelope. The physical boundaries of WSMR do not accommodate the parameters, including higher closing velocities and acquisition ranges, for the fifth and sixth LEAP test flights. In light of the physical parameters, and ABM Treaty requirements, USAKA is the ideal test range available to support the fifth and sixth LEAP test flights.

Launching LEAP intercept vehicles from Meck Island at USAKA requires that the target vehicles be launched from a separate location. A study was performed to identify alternative ranges from which LEAP target vehicles could be launched (ANSER, 1991). The study included an analysis of 11 different launch sites, and is summarized in Table 4. Each of the 11 alternative sites was given a rank score from one to four. Of the eleven alternatives, only Wake Island received a score of one.

TABLE 4 - LEAP RANGE STUDY FOR TARGET LAUNCH VEHICLE

LAUNCH SITE	TARGET VEHICLE EVALUATED	SATISFY MISSION REQUIREMENTS	RANGE FACILITIES CURRENT/PLANNED	COST	COMMENTS	OVERALL EVALUATION
ROI NAMUR	• TALOS/ARIES/ORBUS • STRYPI XII/ORBUS	• MARGINAL	• HAS RAIL LAUNCHER • AND RANGE OPS CENTER	LOW	*• NO GUIDED LAUNCH VEHICLES ALLOWED DUE TO PROXIMITY TO KREMS RADAR	4
MIDWAY	• CASTOR IVA/ORBUS • MINUTEMAN II	• MARGINAL • YES	*• NO LAUNCH CAPABILITY	HIGH	• ENVIRONMENTAL • NO LAUNCH FACILITIES EXIST	3
JOHNSTON ISLAND	• CASTOR IVA/ORBUS	• YES	*• ONLY VEHICLE STORAGE, ASSEMBLY, LAUNCH CONTROL FACILITIES EXIST BUT MOTHBALLED IN POOR CONDITION		• USED IN 1960S FOR THOR MOTORS, ISSUES INCLUDE CHEMICAL AGENTS STORED THERE AND CONTAMINATION OF THOR AREA.	3
OMELEK/ ISLAND	• TALOS/ARIES/ORBUS • STRYPI XII/ORBUS	• MARGINAL	• LAUNCH METEOROLOGICAL ROCKETS. HAVE ONLY A 5K LAUNCHER	•HIGH	• ISLAND SMALL, CURRENTLY USED FOR MET ROCKETS. *• DISPERSION ERRORS AND RANGE SAFETY MAJOR ISSUES	3
ILLEGINNI	• TALOS/ARIES	• MARGINAL	• USED FOR SAFEGUARD PROGRAM *• ALL LAUNCH CAPABILITY HAS BEEN REMOVED	•HIGH	*• ISLAND IS DESIGNATED AS TARGET AREA FOR SAC AND HAS BEEN INSTRUMENTED ACCORDINGLY	3
WAKE ISLAND	• CASTOR/IVA/ORBUS	*• YES	*• LAUNCH PADS AVAILABLE • LAUNCHER COMPLETED, • BUILDINGS AVAILABLE, GSE EXISTS AT SDD	*MEDIUM	*• CAPABILITY TO SUPPORT PEOPLE ON ISLAND • FUEL STORAGE, BUNKERS AVAILABLE • ALL SPFE HARDWARE PLANNING EFFORTS HAVE BASELINED WAKE FOR OVER 2 YRS. OPTIMAL GEOMETRY FOR MISSION	1
VANDENBERG	• MMI	*• NO	• FULLY CAPABLE	MEDIUM	*• REQUIRES ICBM MISSION	3
SHEMYA	• MMI • CASTOR IVA/ STAR37/ORBUS	• YES • MARGINAL	*• NONE AVAILABLE	*HIGH	• REQUIRES LARGE BOOSTERS DUE TO EXTENDED RANGE • NOT PRACTICAL TO INSTALL	3
SUBMARINE LAUNCH	POLARIS/ TRIDENT	YES	SELF CONTAINED ON-BOARD SUBMARINE	*HIGH	SCHEDULE AND COSTS ASSOCIATED WITH NAVY ARE NOT FEASIBLE, NAVY RESPONDS TO OPERATIONAL JCS REQUIREMENTS • NO U.S. POLARIS CAPABILITY (ONLY U.K.)	4
AIR LAUNCHED	PEGASUS	YES	OSC HAS PROPOSAL TO MODIFY L1011 AIRCRAFT	MEDIUM	• LANDING STRIP FOR L1011 IS *• EARLIEST EXPECTED CAPABILITY IS LATE 1933	3 NOTE
WSMR/ GREEN RIVER	CASTOR IVA/ ORBUS	YES	• GREEN RIVER COMPLEX BEEN CLOSED FOR 20 YEARS	MEDIUM	*• RANGE SAFETY ISSUES ARE UNACCEPTABLE, POPULATED AREAS • LAUNCH TOWARDS MEXICO UNACCEPTABLE	4

EVALUATION CODE: 1 = GOOD 2 = ACCEPTABLE 3 = POOR 4 = NOT USABLE *CRITICAL FACTOR EVALUATION

NOTE: THIS OPTION WOULD BE ACCEPTABLE, EXCEPT FOR IOC

2.0 AFFECTED ENVIRONMENT

2.0 AFFECTED ENVIRONMENT

This section of the environmental assessment includes a discussion of the affected environment for those locations at which proposed activities will occur. These locations include those for construction, ground, preflight, and flight tests of components and assemblies. The purpose is to provide the reader with an overview of the environment within which the proposed activities will take place.

2.1 COMPONENT/ASSEMBLY GROUND TEST LOCATIONS

Information encompassing the technical operations of component/assembly ground test participants in the LEAP Program was obtained through extensive interviews. The goal was to identify current activities and the existing environment at the various facilities. Each facility was reviewed to determine existing characteristics in the following areas: Physical setting and man made environment, geology and water resources, air quality, noise, biological resources, threatened and endangered species, cultural resources, infrastructure, hazardous materials and wastes, and safety relevant to determining the potential impacts from executing the proposed activities. However, not all environmental media applied in all cases to the locations reviewed.

2.1.1 Boeing Aerospace and Electronics, Kent, Washington

The Boeing Aerospace & Electronics Company (BAE) is a subsidiary of the Boeing Aircraft Corporation in Seattle. Boeing's multitude of expertise in avionics, aeronautics and sheer size allows for the undertaking of projects whose technical requirements are similar to those proposed. BAE will conduct a test of the propulsion system in the Kent Space Center in a building where such tests have been conducted in the past.

Boeing's environmental management group, under the auspices of its legal department, conducts environmental audits on new projects to assure adherence to environmental

standards and that appropriate permits are obtained. BAE is currently permitted for on-going activities and in compliance with existing regulations relevant to air quality and water quality. There are no known historic or archaeological sites at the facility, and no threatened or endangered species are known to frequent the area (Boeing, 1990).

2.1.2 Hughes Aircraft Company, Missile Systems Group, Canoga Park, California

The Hughes Aircraft Company's (HAC) Missiles Systems Group, located in Canoga Park, California, conducts integration and system level tests, component production, and assembly of technological products which are similar to those of the Standard Test Projectile (STP) and LEAP Auxiliary Equipment (LAE).

The HAC facility is in compliance with state and federal regulations relative to air and water quality. There are no know historic or archaeological sites at the facility, and no threatened or endangered species are known to frequent the area. There are no existing problems relating to geology or hydrology (Hughes, 1990).

2.1.3 Space Data Division, Orbital Sciences Corporation, Chandler, Arizona

Space Data Division (SDD), a division of the Orbital Science Corporation, is a commercial/industrial operation located on 40 acres on the outskirts of Chandler, Arizona. The SDD facility was built in 1989, with two stories and 40-foot ceilings in the 280,000-square foot production and integration bays.

The existing structure houses an engineering wing, an electronics assembly area, a production wing, several build-up/integration bays, environmental bays, and a 10,000-particulate clean room.

Previously conducted environmental audits list the facility as in compliance with all existing environmental regulations. No significant environmental issues have been identified.

There are no known historic or archaeological sites at the facility, and no threatened or endangered species are known to frequent the area (SDD, 1990).

2.1.4 Phillips Laboratory, Edwards AFB, California

Edwards AFB, under the direction of the U.S. Air Force Systems Command, is located approximately 100 miles north of Los Angeles. Phillips Laboratory is located in the eastern portion of Edwards, South of the town of Boron, California.

Residual propellants remaining after vehicle contamination are disposed of in compliance with federal, state and Air Force regulations. Safety procedures are followed as stipulated by the Laboratory's Safety handbook (Phillips, 1990).

Testing at Edwards AFB is conducted by U.S. Air Force or contractor personnel and requires appropriate air quality permits from the Kern County Air Quality Control District (Rule 202.1). The environmental office at Edwards AFB has appropriate environmental permits and exemptions for the planned tests (Paxson, 1990).

2.2 PREFLIGHT AND FLIGHT TEST LOCATIONS

This section includes a discussion of the various locations at which preflight and flight test activities will occur. A description of the physical setting and various environmental characteristics is identified for each.

2.2.1 White Sands Missile Range

White Sands Missile Range is a national range which supports missile testing and development programs for the Army, Navy, Air Force, NASA, and other federal agencies. The U.S. Army Test and Evaluation Command (TECOM) maintains operational control over the Range. Missile development and testing at the Range began in September 1945 under the name White Sands Proving Ground (WSPG). The name was changed to WSMR

on May 1, 1958. Since its inception, WSMR has conducted over 37,000 missile launches, including over 1,000 high altitude launches.

WSMR currently averages, on an annual basis, approximately 450 rocket and missile launches varying in size from hand-held stinger missiles to high-altitude research rockets such as the Aries. High-altitude rocket launches have ranged from a high of 34 in 1987 to a low of 11 in 1984 with 12 launches having occurred in both 1988 and 1989. During 1990, 14 high altitude research rockets were launched from WSMR. Projections for 1991 and 1992 indicate 15 - 18 high altitude research rockets will be launched in each of those years (WSMR NR-PD, 1990).

2.2.1.1 Physical Setting and Man-Made Environment

WSMR is located in south central New Mexico within the Tularosa Basin, and includes two million acres in Dona Ana, Otero, Socorro, Sierra and Lincoln Counties. The installation is approximately 100 miles long and 40 miles wide. Principal facilities at WSMR include the post headquarters area, the Rhodes Canyon Range Center, North Oscura Range Center, and the Tularosa Range Camp.

Population growth in the Las Cruces area, the largest community near WSMR, has increased consistently over the past decade from 46,999 in 1980 to 56,000 in 1989 (city only). Population in Dona Ana County for the same period increased from 96,340 to 128,000. According to the U.S. Department of Commerce, the Las Cruces metropolitan area registered as the eighth fastest growing Metropolitan Statistical Area (MSA) in the U.S. between 1980-1987, with an increase in population of 37 percent. Ninety-four percent of the population in Dona Ana County resides in the Las Cruces MSA (Bureau of the Census, 1990).

The population of Alamogordo (Figure 1) increased from 24,024 in 1980 to 28,520 in 1989. The population in Otero County for the same period increased from 44,665 to 50,800. The population totals do not reflect personnel stationed at Holloman AFB which is located in

the county.

2.2.1.2 Geology and Water Resources

Regional Geology

The Tularosa Basin, in the Mexican Highland Section of the Basin and Range Physiographic Province, is characterized by interbedded limestone and sandstone sequences with some intrusion of volcanic material including basalt flows and granite rock. The Basin is approximately 140 miles long and 40 miles wide, and the floor of the basin is relatively flat. The basin is bounded by the Organ, San Andres and Franklin Mountains to the west, by the Sierra Oscura Mountains to the north, and by the Sacramento, Sierra Blanca and Heuco Mountains to the east. The Jarilla Mountains lie at the south end of the Tularosa Basin and are separated from both Sacramento and Organ ranges by broad stretches of desert lowland. The average elevations of the mountains bordering the White Sands Missile Range vary from approximately 5,500 to 9,000 feet MSL (RGCOG, 1988).

Surficial geology in the Tularosa basin primarily consists of unconsolidated bolson, alluvial and eolian deposits. The Jarilla mountains consist of Cretaceous and Tertiary intrusive rocks. The San Andres Mountains to the west consist of Pre-Cambrian, Cretaceous and Tertiary igneous intrusive rocks and metamorphic facies (Schmidt and Craddock, 1964).

Soil Resources

The area in the vicinity of LC 36 is classified as dune lands and is comprised of deep sand dunes, 3 to 30 feet in height, that are partially stabilized. This is considered a land form rather than a soil due to the frequent modification by the wind (U.S. Army, 1985).

Soils in the area of the Sulf Site are Onite loamy fine sand, described as gravelly fine sandy loam, moderately deep and well drained (NOMTS, 1990).

The debris dispersion areas of the LEAP flights are underlain by 13 soil types. Marcial-Ubar soils, occurring primarily in the vicinity of Range Road 7, are moderately saline and alkaline. The Mimbres-Glendale association occurs primarily west of the Marcial-Ubar soils and are clay loam to silt loams soils. Mead silt loam is found along the floodplain of Salt Creek and is strongly saline and alkaline. Yesum very fine silt loam, which are deep, well drained soils, occur extensively to the east of Salt Creek over fairly level to slight undulating topography. The Yesum-Holloman association includes shallow soils over gypsum beds (Holloman very fine sandy loam, (30%) and partly stabilized gypsum dunes (20%) in addition to Yesum very fine silt loam (35%)). Soils of the Onite-Bluepoint-Wink association occur east of the Yesum very fine silt loam. These soils are not as gypseous as the Yesum soils, but are formed largely in sandy sediments on alluvial fans.

There are three soils types in the area where debris may encroach into the San Andres Mountains. Rock Land, warm consists of very steep rough foothills and low mountain slopes, escarpments, ledges, cliffs and canyons. The rock outcrop is limestone, acid igneous rock, sandstone basalt, shale and gypsum. Elevations of Rock Land, warm ranges from 4,300 to 6,500 feet. The Rock Land, cool soil type is the same soil with an elevation ranging between 6,000 and 8,000 feet. The Deama-Rock outcrop complex is about 40 percent stony loam and 40 percent outcrop.

The Nickel-Tencee association is located east of the Rock Land soils and is gravelly and very gravelly loam. The Lava Flows soil type occurs in the eastern portion of the debris dispersion area. This soil type is composed of basalt lava.

The final two soil types which occur in the debris dispersion area are located near the northern boundary of the White Sands National Monument. Active Dune Land, gypsum consists of gypsum sand dunes known as White Sands. The dunes are dominantly about 30 feet high, but are continually shifted by wind action. Adjacent to the Active Dune Land is Gypsum Land, level. This mapping unit consists of level to nearly level gypsum deposits in an old lakebed.

Surface Water

Large surface lakes and streams are almost non-existent within WSMR boundaries except for gypsum water in Lake Lucero, Salt Creek and the Saline water in Malpais Springs. Salt Creek runs along northwest to southeast through the northwest quadrant of the 50 Mile Impact Area. It fans out into an open lakebed in the southern portion of this area, and then continues into the playas to the south. Many small saline playas are also present in the 50 Mile Impact Area. Numerous intermittent streams, seeps and temporary pools occur at higher elevations of the surrounding mountains ranges (U.S. Army, 1985).

Groundwater

The Tularosa Basin has limited good quality groundwater supplies, which are concentrated along the base of the Sacramento Mountain range at the eastern end of the basin, and the Organ Mountains at the western end of the basin (U.S. DOI, 1984). However, the majority of groundwater supplies in the Basin is classified as saline, with an estimated 98 percent having dissolved solids concentrations excess of 35,000 mg/l, comparable to sea water salinity levels. These highly mineralized water deposits have remained largely undeveloped; consequently, little information is available about the extent to which these saline aquifers transmit and store water (U.S. DOI, 1984).

The White Sands Missile Range complex receives its water from on-site supply wells. These wells tap a natural aquifer supplied by four watershed areas, namely Post, Soledad, Small Missile Range and Bear Canyon in the San Andres/Organ Mountain range and occurring at a depth of 1,318 to 1,347 feet (DOA, 1984). Future potable water considerations include Soledad Canyon in cooperation with Fort Bliss, located adjacent to WSMR.

2.2.1.3 Air Quality

Climatological Conditions

The Tularosa Basin climate is arid with an average annual rainfall of 10 inches and mean annual temperature of 60 degrees Fahrenheit (F). The mean minimum winter temperature is 36 degrees F and the mean maximum summer temperature is 94 degrees F. Climate characteristics include abundant sunshine, low humidity, scant rainfall, and a mild winter season.

Severe weather at WSMR is uncommon. Precipitation, occurring in the form of heavy summer rainstorms, is insufficient for any growth except desert vegetation. Considerable runoff occurs from nearby mountains during prolonged wet spells, occasionally producing intermittent lakes which may persist for several months (U.S. DOI, 1984).

Ambient Air Quality

According to requirements in the Clean Air Act, the United States Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: carbon monoxide; PM 10; suspended particulates less than 10 microns in diameter; sulfur dioxide; nitrogen dioxide; ozone; and lead (Table 5).

The New Mexico air quality standards (NMAQS) applicable to the LEAP emissions are provided in Table 6. The New Mexico air quality regulations also contain guideline values for toxic air pollutants. These guideline values are not considered ambient air quality standards but are used in the evaluation of the content of analysis required for permit applications (see Appendix B).

The WSMR area experiences periodic exceedances of the suspended particulate standard. The primary source of the particulates at WSMR is fugitive dust generated by wind blowing across barren terrain. Significant amounts of hydrocarbons and oxides of nitrogen are

TABLE 5

NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Primary Standard	Secondary Standard
Carbon Monoxide		
1-hour Maximum[a]	35 ppm	35 ppm
8-hour Maximum[a]	9 ppm	9 ppm
Sulfur Dioxide		
Annual Arithmetic Mean	0.03 ppm	--
24-hour Maximum[a]	0.14 ppm	--
3-hour Maximum[a]	--	0.50 ppm
Particulate Matter		
PM-10 (National Standard)		
Annual Arithmetic Mean	50 ug/m³	50 ug/m³
24-hour Maximum[a]	150 ug/m³	150 ug/m³
Ozone		
1-hour Maximum[b]	0.12 ppm	0.12ppm
Nitrogen Dioxide		
Annual Arithmetic Mean	0.053 ppm	0.053 ppm
Lead		
Calendar Quarter Average	1.5 ug/m³	1.5 ug/m³

a Maximum concentration not to be exceeded more than once per year.

b The standard is attained when the expected number of days per calendar year with a maximum hourly average concentration above 0.12 ppm is equal or less than one.

ppm Parts per million.

ug/m³ Micrograms per cubic meter.

Source: The Bureau of National Affairs, 1985.

TABLE 6

NEW MEXICO AIR QUALITY STANDARDS AND IDLH VALUES APPLICABLE TO LEAP PROGRAM

Pollutant	New Mexico Air Quality Standards		IDLH
Aluminum Oxide (As Particulates)	60 ug/m^3	Annual	None
	90 ug/m^3	30-days	
	110 ug/m^3	7-days	
	150 ug/m^3	24-hours	
	10 mg/m^3	8-hours*	
Carbon Monoxide	10,000 ug/m^3 (8.7 ppm)	8-hours	1,500 ppm
	15,000 ug/m^3 (13.1 ppm)	1-hour	
Carbon Dioxide	None		50,000 ppm
Lead	10 ug/m^3	30-days	None
Nitrogen Dioxide	100 ug/m^3 (0.05 ppm)	Annual	50 ppm
	200 ug/m^3 (0.10 ppm)	24-hours	
Hydrogen Chloride	7 mg/m^3	8-hours*	100 ppm
Nitric Oxide	None		100 ppm

* New Mexico Toxic Air Pollutant Permit OEL - These limits are not a standard but used as a value in evaluating permit aplications. The Occupational Exposure Limit (OEL) means the eight-hour time weighted average concentration specified for workroom air in "Threshold Limit Values and Biological Exposure Indices for 1986-1987" as adopted by the American Conference of Governmental Industrial Hygienists, or for compounds not assigned an OEL in that document, the minimum detection limit specified in the National Institute for Occupational Safety and Health "Manual of Analytical Methods", Third Edition.

emitted in the El Paso-Las Cruces corridor. These precursor pollutants react in the presence of sunlight to form ozone, which can be transported for hundreds of miles in the atmosphere. It is likely that WSMR experiences elevated levels of this criteria pollutant under certain meteorological conditions. The WSMR is in attainment of the NAAQS for all other pollutants except particulates.

2.2.1.4 Noise

Noise is defined as undesirable sound. The decibel (dB), the standard unit for sound measurement, represents the acoustical energy present in the environment. The decibel is measured on a logarithmic scale in dBA units, which closely approximates the dynamic response characteristics of the human ear.

Noise impacts on WSMR employees are evaluated according to OSHA and U.S. Army noise criteria. OSHA has established the following dose exposure limits for occupational hearing conservation:

8-hour	-	not to exceed 90 dBA (averaged [Leq] over the time period)
15-minute	-	not to exceed 115 dBA
peak	-	not to exceed 140 dBA

The U.S. Army noise criteria, contained in Chapter 7 of Army Regulation 200-1, suggests limiting the weighted 24-hour noise level to a maximum Level Day/Night (Ldn) of 65. The Ldn is the average, 24-hour A-weighted noise level with a +10 dB penalty applied to the nighttime hours of 22:00 to 07:00.

2.2.1.5 Biological Resources

Noise sources resulting from WSMR activities include weapons firings, supersonic flights, missiles systems tests, radar equipment, and heavy equipment operations. These activities

are not located near surrounding communities, and are in compliance with noise emission standards. A hearing conservation program has been implemented at WSMR to protect personnel working at the range.

Vegetation

Launch Complex (LC) 36 is located at the southern end of the White Sands Missile Range (WSMR) (Figure 2). The area is generally characterized by dunes 4 to 20 feet in height that have formed in association with mesquite (Prosopis glandulosa) shrubs. This mesquite dune association if found extensively on the basin floor throughout the Tulorasa Basin.

The mesquite sand dune standard habitat site description is utilized by the Bureau of Land Management (BLM) in their Integrated Habitat Inventory Classification System (BLM 1985, 1988, 1989a). Since much of the land in the vicinity of LC 36 is in the White Sands and McGregor Ranges managed by the BLM, these habitat types reflect the wildlife habitat on the site. Extensive mesquite coppice dunes occur throughout the Tularosa Basin and characterize one of the major habitat types in the basin.

Vegetative surveys conducted for the HEDI Program (USASDC, 1989b) included the area of LC 36, which contained one of that Program's camera sites. The dominant vegetation around LC 36 is mesquite hummocks (USASDC, 1989b). Although this community has been previously disturbed by historic grazing practices and construction at WSMR, a number of native plants are present, including snakeweed (Gutterezia sarothrae), four-winged saltbrush (Atriplex canescens), desert aster (Macheranthera linearis), sunflowers (Helianthus) and desert marigold (Baileya pleniradiata). Invasive plants found in the area include Russian thistle (Salsola kali), a non-native species, and coyote melon (Cucurbita foetidissima). No protected plant species are known to be present in the area (USASDC, 1989b).

A vegetative survey conducted by WSMR environmental staff for the EXCEDE III project (NOMTS, 1990) at the Sulf Site (Figure 12) documented the occurrence of the following plants species: three-awn (Aristida spp.), plains bristlegrass (Setaras leucopila), dropseed

(Sporobolus spp.), sand sagebrush (Artemisia filifolia), snakeweed, mormon tea (Ephedra spp.), soaptree yucca (Yucca elata), rushpea (Hoffmanseggia jamesii), spreading indigobush (Dalea terminalis), russian thistle, horsenettle (Solanum elaeagnifolium), prickly pear (Opuntia spp.), thistle (Cirsium spp.) and firewheel (Gaillardia pulchella). No threatened or endangered plant species were observed in the area (NOMTS, 1990).

The debris dispersion area of LEAP flights 1 and 2 contain a variety of soils which provide substrates that have a major influence on the distribution of plants in the area. The Marical-Ubar soils are associated with strongly holophytic species such as inland saltgrass (Distichlis stricta), alkali sacaton (Sporobolus airoides), tobosa (Hilaria mutica) and mesquite (Prosopis julifloria). The Mimbres-Glendale association provides substrate for plant species such as alkali sacaton, tobasa, chamiza (Atripliex canescens), creosotebush (Larrea divaricata), and burrograss (Schleropogon brevifolius).

The Nickel-Tencee association provides substrate for plants such as, creosotebush, American tarbush (Flourensia cernua), mesquite and mariola parthenium (Parthenium incanum).

The Rock Land, warm soils are typically vegetated with black grama (Bouteloua eriopoda), blue grama (B. gracilis), side-oats grama (B. curtipendula), mountain mahogany (Cercocarpus montanus), algertia (Berberis trifoliata), shrub live oak (Quercus Gambelli), and soaptree yucca (Yussa elata). The Rock Land, cool and Deama-Rock outcrop soils, where vegetated, contain species such as pinyon pine (Pinus edulis), oneseed juniper (Juniperus monosperma), Metcalfe muhly (Muhlenbergia metcalfei), Pine mulhy (M. dubia), Chihuahua lovegrass (Eragrostis erosa) side-oats grama, Fendler three-awn mountain mahogany (Aristida fenoleriana), and soaptree yucca. These soils also may be suitable substrate for the Todsen's pennyroyal (Hedeoma todsenii). The Todsen's pennyroyal is on the federal endangered species list and is known to occur in Rhodes Canyon in WSMR.

The LEAP 3 flight has a debris dispersion area east of Range Road 7. Some of same soils associations are contained within this dispersion area, as were found in the LEAP 1 and 2 dispersion area. The northern dispersion area contains the Mimbres-Glendale and Marcial-

Ubar associations. These associations are vegetated with the same species described above for those soil types. In addition, the Mead silt loam soil found in this dispersion area has the same plant associations as the Marcial-Ubar soil.

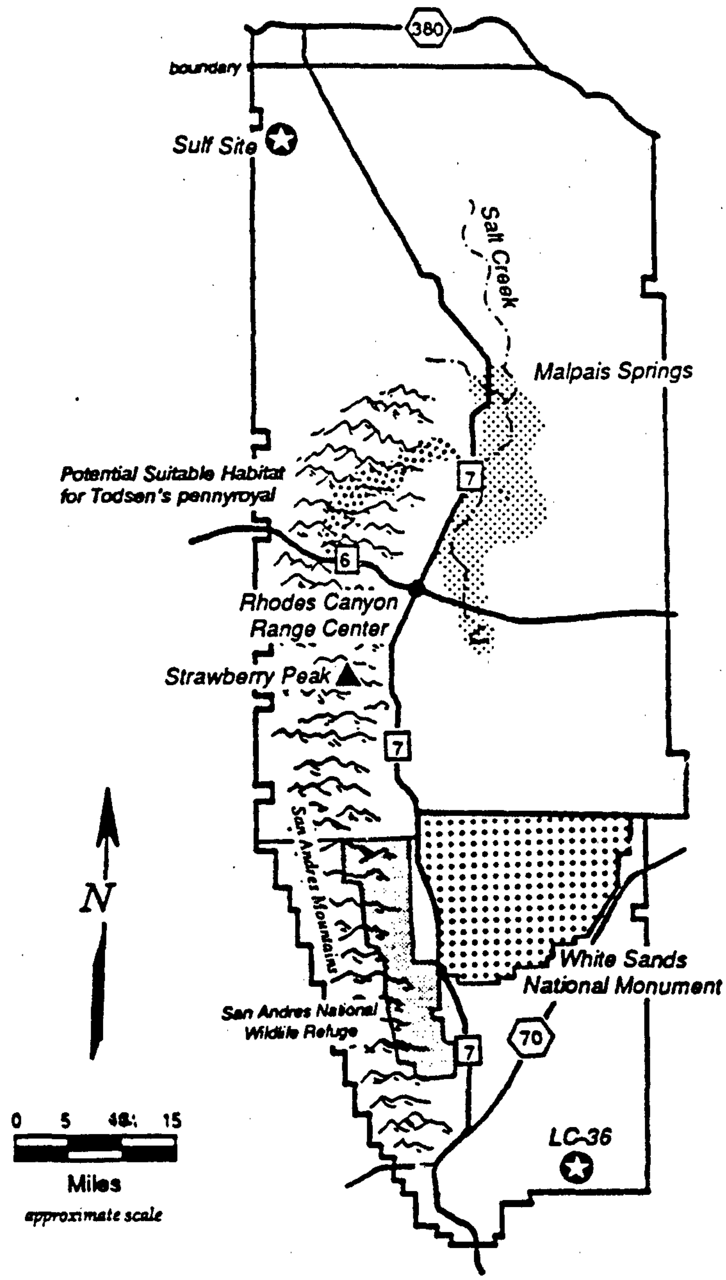
Extensive areas of the dispersion area for LEAP 3 are underlain by Yesum very fine sandy loam and Yesum-Holloman soils. These soils are vegetated by rough colendia (Colendia hispidissima), gyp grama (Bouteloua breviseta), Torrey ephedra (Ephedra trifurca), alkali sacaton, chamiza and mesquite.

In the dispersion area underlain by Lava Flows only sparse vegetation that grows in pockets of soils in the rock is expected. The species found in this setting are chamiza, creosotebush, mariola parthenium, black grama and alkali sacaton.

The Onite-Bluepoint-Wink association is vegetated by species such as mesquite, sand dropseed (Sporobolus cryptandrus), soaptree yucca, chamiza and Ephedra sp.

The dispersion area near the White Sands National Monument contains Active Dune Land which is vegetated by giant dropseed (Sporobolis giganteus), spike dropseed (S. contractus), iodinebush (Allenrolfea occidentalis), and seepweed (Suaeda suffrutescens). This area is also underlain with Gypsum Land which is sparsely vegetated with iodinebush.

The LEAP 4 dispersion area contains the following soil types and their associated vegetation: Mead silt loam, Marcial-Ubar association, Mibre-Glendale association, Nickel-Tencee association, Yesum very fine sandy loam, Yesum-Holloman association and Activ Dune Land.



LEAP ENVIRONMENTAL ASSESSMENT	BIOLOGICAL RESOURCES WSMR

Figure 12

Terrestrial Wildlife

Wildlife refuges in the region surrounding WSMR include the Bosque del Apache National Wildlife Refuge in the Rio Grande Valley, the Bitter Lake National Wildlife Refuge near Rosswell, NM, and the San Andres National Wildlife Refuge in the San Andres Mountains.

The wildlife habitat in the mesquite-snakeweed complex surrounding LC 36 supports a number of common desert species. Biological surveys conducted for the HEDI Program (USASDC, 1989b) recorded the presence of mourning doves (Zenaida macroura), sage sparrows (Amphispiza belli), side blotched lizards (Uta stansburiana) and antelope ground squirrels (Ammospermophilus leucurus). No unique or essential habitat for protected species was reported for a 4-mile radius area around LC 37, which includes LC 36.

Wildlife (or their signs) observed in the vicinity of the Sulf Site include: lesser earless lizard (Hulbrookia maculata), eastern fence lizard (Sceloporus undulatus), marbled whiptail (Cnemidophorous tigris marmoratus), whiptail (Cnemidophorus spp.), kangaroo rat (Dipodomys spp.), coyote (Canis latrans), oryx (Oryx gazella), woodrat (Neotoma spp.), black-tailed jackrabbit (Lepus californicus), ash-throated flycatcher (Myiarchus cinerascens), Scott's oriole (Icterus parisorum) and horned lark (Eremophila alpestris) (NOMTS, 1990).

Wildlife habitat in the LEAP flight's dispersion area is primarily arid shrubland dominated by 4-wing saltbrush with some areas dominated by mesquite or creosote. Although occurring in relatively minor amounts, riparian communities along Salt Creek and Malpais Spring are undoubtedly very important elements of the wildlife habitat in the area. Migrating shorebirds and waterfowl may be attracted to the saline lakebeds, although the high salinity probably makes their utilization less than would be expected in an arid environment.

Large mammals (or their signs) observed during site visits in the area east of Rhodes Canyon Ranger Center include feral horse and oryx. Badger (Taxidea taxus berlandieri) burrows were also observed in several areas. Mountain lion (Felis concolor) and mule deer

(Odocoileus hemionus) may also be expected to occur in this area. No small mammals were observed, but the shrubland would be expected to host a variety of species similar to those found in mesquite and creosote dominated communities (i.e. [illegible] 36). This is supported by the observations of redtail (Buteo jamaicensis) and marsh hawks (Circus cyaneus), which prey on these type of species. In the dispersion areas for LEAP flights 1 and 2, the species expected include mule deer and mountain lion.

Aquatic Resources

There are few places with permanent surface water in the Tularosa Basin. No aquatic habitat exists on the LC 36 site. There are some playa lake beds on the WSMR out in the basin. The most noteworthy of these is Lake Lucero, a saline playa about 20 miles to the west. There are a few permanent springs and small streams on the WSMR including Salt Creek, Mound Spring, and Malpais Spring (U.S. Army, 1985), and there are some permanent streams draining the Sacramento Mountains and Otero Mesa to the east (BLM, 1985).

Wetlands

Since the Tularosa Basin is a very arid region, wetlands are uncommon. The National Wetlands Inventory Map for the area around LC 36 (Elephant Mountain, New Mexico) shows no wetlands on the site. There are emergent wetlands associated with some permanent springs, such as Mound and Malpais Springs, and playa basins have associated wetlands.

2.2.1.6 Threatened and Endangered Species

The U.S. Fish and Wildlife Service (USFWS) has identified two threatened or endangered species which could be affected by the LEAP Test Program - the Aplomado Falcon (Falco femoralis septentrionalis) and the Todsen's pennyroyal (Hedeoma todsenii). Both of these species are listed as endangered by the USFWS.

The Aplomado Falcon is officially not known to inhabit New Mexico. Only two recent sightings of this species are known to have occurred in New Mexico. These two sightings were west of Carlsbad, New Mexico in the Guadalupe Mountain Range (personal communication, Gerry Roehm, USFWS). This species is not known to occur on WSMR.

The Todsen's pennyroyal is known to occur on WSMR in the Rhodes Canyon. Its preferred habitat is gravelly gypsum limestone soils, on steep north- or east-facing slopes at an elevation above 6,000 ft., and under pinyon-juniper overstories. Data sources, the Soil Survey of WSMR and USGS Quadrangle maps, were examined to determine potential suitable habitat for the Todsen's pennyroyal. The location of potential suitable habitat in the vicinity of the dispersion areas for LEAP flights is illustrated in Figure 12.

In addition, two other species were sited by the USFWS as being of concern -- the White Sands pupfish (Cyprinodon tularosa) and the desert bighorn sheep (Ovis canadensis mexicana).

The dispersion areas for LEAP flights 3 and 4 contain habitat for the White Sands pupfish (Cyprinodon tularosa) (Figure 12). The White Sands pupfish is endemic to the Tularosa Basin and is a listed species (state - Endangered, Group 2; Federal Candidate Category 2). The White Sands pupfish is found in Malpais Spring and Lost River, Otero County; Salt Creek, Sierra County; and Mound Springs, Lincoln County.

A population of desert bighorn sheep (Ovis canadensis - state Endangered) is found in the San Andres Mountains. This is the last resident, indigenous population of desert bighorns in the state of New Mexico (Taylor, 1989). There are approximately 25 - 30 animals left in two or three herds. The majority of the animals are located in the San Andres National Wildlife Refuge. A small population of approximately 9 animals, representing one-third of the herd, are located at Strawberry Peak north of the Refuge (Figure 12). The herd has been suffering from an outbreak of psoroptic scabies since 1978.

The bighorn sheep population, in the area of WSMR, has been slowly declining. This is due to the diminished amount of range available to the sheep, the introduction of diseases from domestic animals, and disruption in lambing due to the man-made disturbances. The area of WSMR, where the sheep occur, is subject to intense noise levels from launch activities at the range. During the lambing season, if the ewe is disturbed and flees, the lambs may be endangered since, initially, they are unable to keep up with the ewe. It is for this reasons that any overflights of bighorn sheep territory are likely to be restricted during the lambing season, and debris recovery may be postponed until the sheep leave the vicinity.

The White Sands pupfish is present in high saline, intermittent creek beds and streams. The fish, when present, is often found in high densities. It is tolerant of a wide range of salinities and temperatures, but is sensitive to fluctuations in water flows, changes in water quality due to man-made chemicals or pollutants, and disturbances to the stream bed. Potential impacts from launch debris that may land in known stream habitat for the White Sands pupfish should be minimized, and recovery operations are required to disturb as little habitat as possible.

Threatened, endangered, or sensitive species found in the region around LC 36 are shown in Appendix B. Animal species from this list that have been reported by the BLM to occur or are expected to occur in the mixed shrub or creosote hill habitat types include the Texas horned lizard (Phrynosoma cornutum - Federal Candidate, category 2), ferruginous hawk (Buteo regalis - Federal Candidate category 2), and willow flycatcher (Empidonax trallii - state Endangered, group 2, and Federal Candidate category 2). Bald eagles (Haliaeetus leucocephalus - Federal Endangered) are not likely to occur in the vicinity of LC 36, although they have been observed in the Lake Lucero area and in the lower elevations of the Sacramento Mountains (Howard, 1989; Taylor, 1989). Peregrine falcons (Falco femorali septentrionalis - Federal Endangered) are expected to forage in the project vicinity, but are not likely to nest there (BLM, 1989b; Howard, 1989; Taylor, 1989). Whooping cranes (Grus americana - Federal Endangered) winter in the Rio Grande Valley (especially in the Bosque del Apache National Wildlife Refuge) and often flock with

sandhill cranes (Grus canadensis), which are known to use some of the playas in the western portion of the Tularosa Basin (Taylor, 1989). Consequently, it is possible that they could fly over the site. Likewise, white-faced ibis (Plegadis chihi - Federal Candidate category 2) may fly over the site, as they are known to stop at wastewater ponds at Holloman Air Force Base (Hubbard, 1990; U.S. Army, 1987). Threatened and endangered species potentially present at the Sulf Site and not listed in Appendix B, include the common ground dove (Columbina passerina), state Endangered, Group 2, and the common button cactus (Epithelantha micromeris), State Endangered (NOMTS. 1990).

The following state listed plant species may also be found in the northwest quandrant of the 50 Mile Impact area:

Daggerthorn cactus	Opuntia clavata
Graham's prickly pear cactus	Opuntia grahami
Grama grass cactus	Toumeya papyracantha
Gypsum wort	Pseudoclappia arenaria
Mescalero milkwort	Polygala rimulicola var. mescalerum
Organ Mountain evening primrose	Oenothera organensis
Tall prairie gentian	Eustoma exaltatum
Tall rabbitbrush	Chrysothamnus pulchellus elatior
Zephyr lily	Zephyranthes longifolia

2.2.1.7 Cultural Resources

The WSMR contains a variety of known cultural resources dating from both the prehisto and historic period (U.S. Army, 1985). Although WSMR has been the subject of numerc cultural resource management studies (Whalen, 1979; Soil Systems, 1983), approximat five percent of the property has been subject to archaeological survey and reconnaissance (Burton 1991).

Predictive models for the location of prehistoric sites suggest that the entire range may contain as many as 100,000 archaeological sites. At present an estimated 2,500 prehistoric archaeological sites have been recorded for the installation (Burton 1991). Prehistoric sites include examples from the Paleoindian (10,000 - 5,000 BC); Archaic (5,000 BC - AD 1); Pithouse (AD 1 -1100); and Pueblo (AD 1100 - 1400) periods.

Historic sites appear to be less numerous. Mapping sources indicate that at least 32 ranches were included in the WSMR property in 1915. Fifteen additional ranches were established prior to 1928. In the 1940s, 36 ranches were located within WSMR lands. In all, the remains of approximately 83 historic ranches may be located on WSMR property.

WSMR also includes the White Sands National Monument established in 1933 and the Trinity Site, where the world's first atomic weapon was exploded, listed on the National Register of Historic Places. The New Mexico cultural property register also lists the Army Blockhouse/V-2 Gantry Crane and the 500K Static Test Stand.

2.2.1.8 Infrastructure

WSMR manages its own water treatment and storage and wastewater collection and treatment system. Solid waste is collected and disposed in landfills that are approved by the Environmental Improvement Division of the State of New Mexico (U.S. Army, 1985).

Natural gas is supplied to WSMR by the El Paso Natural Gas Company. El Paso Electric Company provides approximately 90 percent of the installation's electrical needs with the balance provided by the U.S. Bureau of Reclamation (U.S. Army, 1985). Previous environmental documentation does not identify significant utility and infrastructure issues at WSMR.

2.2.1.9 Hazardous Materials and Wastes

Hazardous materials used for rocket launch operations are used and stored at six general areas at WSMR, and are identified in the WSMR Installation Environmental Assessment. In addition to these, there are numerous other Petroleum Oil and Lubricant (POL) Storage tanks at remote sites on the installation. The six general areas include:

- the POL storage facilities in the Post Area,
- the POL storage facility at LC 38,
- the liquid propellant storage area,
- the Polychlorinated Biphenols (PCB) transformers and capacitors,
- the High Energy/Laser Systems Test Facility, and
- the pesticide storage facility.

2.2.1.10 Safety

Operations at WSMR are guided by Army and OSHA regulations and by safety programs implemented by three offices under the final approval authority of the Commanding General. The Installation Safety Office is a staff function to the Commanding General's Office. The Operations Control Division within the National Range Operations Directorate administers all other safety programs at WSMR. These are separated into two functions; Flight Safety Branch which provides safety planning and documentation support (includes Missile Flight Safety Operational Plans and hazard analyses) and Safety Engineering Branch which provides flight termination research and development and termination support system design procurement and fabrication (U.S. Army, 1987).

Preparation of safety documentation is governed by the WSMR Range Users Handbook (1989) and WSMR 385-15 which prescribes the policy, procedures and the responsibilities associated with preparing Safety Standing Operation Procedures (SSOP). Project proponents must prepare an SSOP covering all ground activities engaged in hazardous operations on WSMR. This document is reviewed by the Installation Safety Office and

other WSMR offices. The Chief of the Safety Office will provide final approval, signature, and numbering. The SSOP will identify safety distances and other requirements, such as emergency procedures, and procedures for disposing of hazardous materials.

The project proponent must also prepare a Missile Flight Safety Operation Plan (MFSOP) which is submitted to the Flight Safety Branch for review. The review is conducted by a panel that includes both the Flight Safety Branch and Safety Engineering Branch. Once the MFSOP is approved, Operational Directive is prepared by National Range Operations indicating how WSMR will support ground safety, flight safety, telemetry, etc.

2.2.2 U.S. Army Kwajalein Atoll (USAKA)

In 1989, the U.S. Army prepared an installation EIS for USAKA. The USAKA EIS discusses the existing environment and significant issues in detail, and has been incorporated in this document by reference. This section summarizes the affected environment section of that document. Additionally, changes in procedures and the affected environment since publication of the EIS are also included herein. For a more complete discussion of the USAKA Affected Environment, the reader is referred to that document (USASDC, 1989a).

2.2.2.1 Physical Setting and Man-Made Environment

Kwajalein Atoll is a coral reef containing approximately 100 islands surrounding the largest lagoon in the world. The Atoll is located in the North Pacific Ocean 4,278 miles southwest of Vandenberg AFB, and 2,136 miles southwest of Honolulu (Figure 3). The Kwajalein Atoll islands are part of the Republic of the Marshall Islands.

The United States government leases 11 of these islands: Kwajalein, Roi-Namur, Meck, Ennylabegan, Legan, Illeginni, Gagan, Gellinam, Omelek, Eniwetak and Ennugaret. The islands, totaling 3,584 acres (5.6 square miles), are used by the Department of Defense as a Major Range Testing Facility Base. The facility is used to conduct launches which are allowed under the 1972 Anti-Ballistic Missile (ABM) Treaty. Ebeye, Ennubirr,

Ennylabegen, Ebadon and Majetto Islands are inhabited by the Marshallese. Of the 11 USAKA islands; Kwajalein, Meck and Roi-Namur are the most heavily developed. Kwajalein Island is the headquarters for missile range operations.

2.2.2.2 Geology and Water Resources

Island Geology

All islands of the atoll are nearly flat, with few natural points that exceed 15 feet above mean sea level. Reef rock is formed entirely from the remains of marine organisms such as reef corals, coralline algae, foramnifera, and others. Soils are coarse, grain size, alkaline, and have a low organic matter. The organisms that form the reefs are vulnerable to sedimentation, burial, and changes in circulation caused by man's development activities.

Water Resources

Rainfall is the primary source of fresh water for USAKA. The principal rainfall season is from May through November with an annual average rainfall of 104 inches. Rainfall is collected directly in catchments or, after percolation through the soil, is pumped from the groundwater for fresh water use.

Groundwater is obtained from a series of lenses of freshwater that floats atop deeper marine waters in the subsurface rock strata. Due to fluctuations in rainfall, groundwater is essential to the supply of potable water at USAKA. Chloride levels in the groundwater may rise as much as 100 or 150-mg/l during the dry season and may reach or exceed the potable limit of 250-mg/l during pronounced dry seasons or droughts.

Marine water quality around the USAKA island has generally been satisfactory, except in the immediate vicinity of a few point and non-point sources including sewage, suspended sediment, and sandblasting material. Water quality remains satisfactory due to the generally good mixing and dilution from tidal, tradewind and wave-generated offshore currents.

2.2.2.3 Air Quality

The climate at USAKA is classified as tropical marine, characterized by relatively high annual rainfall and warm to hot, humid weather. Annual average rainfall is 104 inches. Average monthly temperature range from 80 to 85 degrees F. The lowest temperatures during the year are about 70 degrees F, and the highest temperatures are about 90 degrees F.

Ambient air quality at USAKA is generally characterized as good. Pollutant concentrations throughout most of the island are within ambient air quality standards. Some exceedances of CO, PM10, and NO_x occur west of both Power Plant 1 and the solid waste burning pit of Kwajalein Island. The exceedances are primarily the result of burning of solid waste in a forced air incinerator and emissions from the power plants. New air quality controls are being implemented. A new solid waste incinerator with air pollution controls is scheduled for completion in April 1993.

2.2.2.4 Noise

Primary noise generating sources at Meck Island include diesel engine generators; building air conditioning units; and heavy equipment such as forklifts, trucks, etc. Secondary noise sources include helicopters and marine craft

2.2.2.5 Biological Resources

There are 315 vascular flora species at USAKA, 61 percent of which are cultivated plants. There are 51 wildlife species known to inhabit the islands, including many species of migratory and nesting birds. These nesting species have been reduced in numbers due to the loss of nesting habitat from construction activities at USAKA. Marine habitats at the Kwajalein Atoll include ocean reefs, lagoon reefs, lagoon floor and sand flats, harbors, piers, quarries, and sea grass beds. Several reef species are present on the islands. The species are important due to their recreation and subsistence value to the indigenous population

and maintenance of the physical foundation of the islands.

2.2.2.6 Threatened and Endangered Species

There are no threatened or endangered terrestrial plant or animal species on USAKA. Threatened or endangered marine species that may be found in the waters surrounding the Kwajalein Atoll include the green sea turtle (Chelonia mydas - U.S. listed threatened species), the hawksbill turtle (Eretmochelys imbricata - U.S. listed endangered species), the giant clam (Tridacna gigas - proposed for listing by the Republic of the Marshall Islands and the U.S. National Marine Fisheries Service), and a rare seagrass (Halophilla minor). Turtle nesting has been alleged, but not documented on the USAKA islands (Clapp, 1988)

Threatened or endangered species found in the waters surrounding Kwajalein Atoll include the green sea turtle, the hawksbill turtle, the giant clam, and a rare seagrass. All of these species are vulnerable to the same types of impacts, namely those that disturb the habitat directly, or changes in water quality. Changes in water quality may include runoff or discharges from adjacent lands, which contribute to increases in turbidity and pollutant loadings.

Sessile species, such as the giant clam and seagrass, are particularly vulnerable to changes in water quality since they cannot move out of the area. However, adverse changes in water quality would also affect the sea turtles, either directly in exposing them to toxic or hazardous substances, or indirectly through damage to their food sources. These types of impacts can be avoided through the use of proper treatment of wastewater disposal and prevention of direct impacts to the tidal and subtidal environment where these species are known to occur.

2.2.2.7 Cultural Resources

Kwajalein Atoll contains a wide variety of both prehistoric and historic resources. Prehistoric resources date from approximately 1,000 BC until European contact in the mid-

sixteenth century. Historic resources may date from the sixteenth through twentieth centuries.

Kwajalein and Roi-Namur Islands have been included on the National Register of Historic Places since 1984 for their association with important World War II engagements in 1944. These properties are known as the Kwajalein Island Battlefield National Monument and the Roi-Namur Battlefield National Monument. Architectural resources from the World War II period survive in greatest density upon Roi-Namur Island. Potential underwater cultural resources associated with warships sunk during World War II have not been investigated for the Kwajalein Atoll lagoon.

2.2.2.8 Infrastructure

Operations at USAKA include provision of potable water treatment, wastewater treatment, solid waste removal, medical services, education, and housing to the personnel stationed at the base.

The wastewater treatment plant on Kwajalein Island is near its design hydraulic capacity. The plant handles the load without performance problems. Wastewater on Roi-Namur is handled through four tank/leach fields and one outfall to the ocean. A new sewage treatment system is scheduled for construction on Roi-Namur in 1994. Wastewater on Meck Island is handled through a septic tank and leach field system.

Kwajalein and Roi-Namur Islands have established solid waste collection and separation operations. Combustible solid waste is burned in open-air pits. Most noncombustible waste is buried in landfills or open dumps. Installation of temporary rotary-kiln incinerators in 1991-92 will serve as a temporary mitigation for open-air burning. Construction debris is being removed from remote sites to the Kwajalein or Roi-Namur landfills.

Housing facilities are located solely on Kwajalein and Roi-Namur Island. The majority of this housing is substandard, and there is a deficit of standard units. Transient housing at

USAKA includes the use of open barracks. In addition, there are capacity problems in the USAKA school system, primarily in grades K through 6. There are no infant child care facilities at USAKA.

2.2.2.9 Hazardous Materials and Wastes

Activities related to the use and storage of hazardous materials and wastes at USAKA are concentrated on Kwajalein, Roi-Namur, and Meck Islands. Hazardous materials include rocket propellants, explosives, paint products, explosives, and pesticides. Hazardous wastes include asbestos, solvents, paint products, and PCB's. Hazardous materials and wastes are removed from USAKA for ultimate disposal, including recycling. Hazardous waste at USAKA is regulated under RCRA guidelines per Section 161 of the Compact of Free Association (48 USC 1681). A new hazardous materials facility is planned for construction in 1993.

2.2.2.10 Safety

Safety measures at USAKA must address handling and storage of explosives, fuels, rocket propellants, construction operations, missile assembly and storage, launch activities, and toxic and hazardous waste handling.

Programs involve compliance with OSHA regulations and USAKA Regulation 385-75 governing treatment of explosives. These regulations are implemented by the USAKA Safety Office. Launch facility operations are subject to review by the Department of Defense Explosives Safety Board. Handling of hazardous waste is regulated by 29 CFR 1910 (OSHA).

2.2.3 Wake Island

This section provides an overview of the environmental setting at Wake Island that will be affected by LEAP flights. The description of the physical environment of Wake Island

provided in this section was derived from descriptions found in the Starbird (USASDC, 1987), Starlab (USAF, 1990), and Brilliant Pebbles (classified/SDIO, 1990) EAs.

2.2.3.1 Physical Setting and Man-Made Environment

Wake Island is a coral atoll located midway between Guam and Hawaii at 19° 18' N latitude and 166° 38' E longitude. The V-shaped atoll consists of three smaller islands -- Wilkes, Wake, and, Peale (Figure 5). The islands are joined by causeways or bridges and surround a shallow lagoon. Wake Island is about 4.5 miles long and 2.0 miles wide, with a total area of approximately 2,600 acres. A bank reef completely circles the islands and varies in width from 30 to 1,100 yards. Water crosses the western reef to enter a lagoon, which has an area of 3.75 square miles. The shoreline of the atoll is 21 miles long. Beaches surrounding the three islands range in width from 20 to 170 yards.

Wake Island proper is the largest of the three islets, with a 150- by 9,850-foot runway, refueling and support facilities, administrative offices, and quarters for personnel (USAF, 1990). Wake serves as a mid-Pacific emergency landing site for all aircraft; however, routine transient traffic must obtain permission from the USAF 15th ABW before using Wake facilities. Electrical power is provided by diesel generators located on the northwest end of Wake Island proper (USAF, 1990).

Located on Peale Island is a Thai temple, numerous recreational facilities, and access roads running along and across the island. Ruins of pre-World War II (WWII) transpacific flying boat facilities, a WWII Japanese gun emplacement, beach houses and post-WWII Coast Guard facilities are also located on the island. Wilkes Island is the site of a liquid fuel storage area and a FAA navigational facility. Access to Wilkes and Peale from Wake is possible via existing roads. Additional physical description of Wake Atoll, including its beaches and lagoons, is available in the National Marine Fisheries Service (NMFS) Sea Turtle Assessment for Wake Island prepared for the Starlab Program (USAF, 1990).

2.2.3.2 Geology and Water Resources

Island Geology

The islands are essentially flat, with a maximum elevation of 21 feet mean sea level (msl). The "soils" consist of a thin layer of organic material (in vegetated areas) overlying highly permeable sand and coral.

Water Resources

Approximately 35 inches of rain falls annually. Much of it percolates into the ground, though some runs off into the lagoon or ocean. Approximately 10 to 20 percent evaporates or is transpired through vegetation. The only open water area on the islands is a 35-acre water catchment basin that provides drinking water. Nine wells collect brackish water used as power plant cooling water, as feedwater for the desalinization plant, and for sewerage (USASDC. 1987).

2.2.3.3 Air Quality

Wake Island's weather is pleasant and relatively uniform throughout the year. Average daily high and low temperatures are 85° and 75°, respectively (NOAA, 1990). Mean wind speed is 13.8 miles per hour, and the prevailing wind direction is east-northeast.

Air quality at Wake Island is good (Leong, 1990). The principal pollutant emission sources are the power plant, motor vehicles, fuel storage tanks, open burning of trash at the base landfill, aircraft operations, and infrequent rocket launches. The small land area and near-constant sea breezes ensure rapid dispersion of exhaust emissions. No measurements of ambient air quality are known to be available.

2.2.3.4 Noise

Natural background sound levels on Wake Island are relatively high due to wind and surf. Background levels can mask the approach of trucks on base roads, and personnel are not always aware of aircraft landings. No measurements of ambient sound levels are known to be available.

Manmade sources of noise at Wake Island are associated with airfield operations, typically two to five flights per day, and base maintenance activities. Rocket launches have occurred on an infrequent basis in the past. In addition, hearing protection is required for those personnel engaged in aircraft operations.

2.2.3.5 Biological Resources

The vegetation on Wake Island consists of relatively few plant species. Shrubs -- naupaka (Saevola sp.) and beach heliotrope (Tournefortia sp.) -- are the predominant vegetation. Coconut palms and ironwood trees occur occasionally, but are not native species (USASDC, 1987). A description of species that were observed on the various Starbird sites during a recent survey by USFWS is available in the Starlab EA (USAF 1990).

Wake, Peale, and Wilkes Islands provide nesting habitats for a variety of species of migratory seabirds that are widely distributed throughout the tropical Pacific (Pratt et. al., 1987, cited in USAF, 1990a). Nesting occurs primarily on the relatively undisturbed Wilkes and Peale Islands (Figure 5). Presently, no nesting is known to occur on Wake Island, although a suitable habitat is present (USAF 1990).

During a recent survey of Wake Atoll by the USFWS for the Starlab EA (USAF, 1990), four species (red-footed booby, brown booby, masked booby, and sooty tern) were observed nesting on Wilkes Island, but none were reported for Wake Island. Three sooty tern colonies were reported for Peale Island. A seasonal presence of the Red-tailed tropic bird,

White terns, Black noddies, and Great frigatebirds is possible. These species along with the sooty tern, are protected under the Migratory Bird Treaty Act (USAF, 1990). Other wildlife on the islands includes rats, feral cats, and two dogs. Although there is some evidence of predation by feral cats on nesting sea birds, it is not considered to be a significant impact to the sea bird population (USAF 1990).

Near-shore fishes considered highly desirable for food and recreation purposes, grouper (Cephalepholis argus), and jacks (family Caranjidae), are abundant (Gooding, 1971; in USAF, 1990). No freshwater habitat occurs on Wake Island.

2.2.3.6 Threatened and Endangered Species

The green turtle (Chelonia mydas), a threatened species under the Endangered Species Act of 1973, has been observed in the vicinity of Wake Atoll and in the lagoon (Balazs, 1987, in USASDC, 1987). A recent survey and Sea Turtle Assessment by the NMFS indicates that forage is available on the reef faces for the turtles and a small resident population may exist. Habitat suitable for sea turtle nesting is also present on the island, though no nesting is known to occur (Nitta, 1989, in USAF, 1990). The 15th ABW at Hickam AFB, which has overall responsibility for the operation of Wake Island, has agreed to assume responsibility for a program to educate all personnel working on, or visiting Wake Island Atoll not to harm or harass any sea turtles found in the near-shore waters.

Marine mammals protected under the Marine Mammal Protection Act of 1972 that may be present in the waters around Wake Island include the Pacific bottlenose dolphin (Tursiops truncatus gilli), Spinner dolphin (Stenella longirostris), Cuvier's beaked whale (Ziphius cavirostris), and the Hawaiian monk seal (Monachus schauinslandi) (USAF, 1990). The monk seal is also listed by the USFWS as an endangered species. No other threatened or endangered fishes, terrestrial plants, or animal species occur on the islands (USASDC, 1987; USAF, 1990).

2.2.3.7 Cultural Resources

Wake Island has many structures abandoned in place since WWII, when the island was the site of battles between the United States and Japan. In 1985, Wake Island was designated a National Historic Landmark to preserve these resources (USASDC, 1987). All Japanese structures and fortifications and American ammunition magazines are considered historic sites in the designation. Through an agreement between Japan and the U.S. Department of State, all Japanese remains were removed and returned to Japan. In accordance with the Starbird EA mitigation strategy, an archaeological survey was conducted of Starbird sites and archaeological monitoring was performed during construction. No historical or cultural resources are located near the Starbird sites where the target launches will take place. Available information (Department of the Navy, 1990) indicates several known WWII Japanese structures on Peacock Point, including pillboxes, bunkers, a blockhouse, and a magazine. A more detailed history and inventory of the historical sites on Wake Atoll was included in the Starbird document (USASDC, 1987).

2.2.3.8 Infrastructure

Utility service capacity at Wake Island was designed for a much larger population than is currently present. Wake Island's current permanent party personnel are far fewer than in the 1970s (up to 1,600 personnel) (USASDC, 1987). At present, approximately 170 personnel are involved with Wake Island airfield operations. In addition there is adequate support for 200 to 250 additional personnel for at least 30 days (Cannella, 1990). All persons on Wake Island are associated with operations of the Air Station and live in USAF housing (USAF, 1990).

Power generation, airfield, port, telephone, roadway, housing, and sewer and water treatment facilities that support the mission are maintained regularly. Electric power is provided by a central generating station that contains four operating, permanently installed, diesel-driven generators with a total capacity of 3,200 kilowatts (kW), and a supplemental 1,000-kW diesel generator. The current demand at Wake is approximately 1,200 kW.

Nonessential facilities have been allowed to deteriorate in place, and a program to remove these facilities is underway.

Wake Island airfield has a dual water system -- fresh water for potable supplies and bathing, and brackish water for sewerage. Potable water is supplied via the capture of rainwater in a 35-acre catchment area. This system was constructed to serve the base's population in the 1960s; however, its full design capacity is not known. A desalinization plant that provides a backup to the rainwater catchment treats brackish well water at a capacity of 80,000 gallons per day. The wells also provide water for the sewer system, which operates through a treatment plant and ocean outfall off Peacock Point. The sewer system and treatment plant served the 1960s peak base population and their full design capacity is not known (Leong, 1990).

2.2.3.9 Hazardous Materials and Wastes

Hazardous materials that are typical of airfield and base maintenance are used at Wake Island. Because of the limited support mission at Wake and the correspondingly small quantities of hazardous materials used, custody and disposal of hazardous materials are maintained through the 15th ABW at Hickam AFB (Leong, 1990).

Past hazardous waste disposal sites on Wake Island were identified and evaluated during a Phase I records search in 1984 (Engineering-Science, 1984). This records search is the initial phase in DoD's Installation Restoration Program to identify and evaluate past hazardous material disposal sites on DoD property. Waste sites associated with airfield activities and disposal of WWII debris were found on Wake and Wilkes Islands; no such disposal sites were found on Peale. An old sanitary landfill has been covered and abandoned, and a new landfill was opened closer to burn area No. 2. The Phase I report (Engineering-Science, 1984) provided recommendations for land use restrictions for twelve categories of land use activities (housing, agriculture, water well development, recreation, etc.). With the exception of the old landfill, on which construction or excavation was not recommended, activities and uses proposed for LEAP (excavation, vehicular traffic, and

materials storage) were not restricted.

2.2.3.10 Safety

Operations at Wake Island are guided by Air Force and OSHA regulations and by safety programs implemented by the base commander and operating support contractor. In addition to standard plans, The Wake Island Disaster Preparedness Operations Plan 355-1 (17 February 1989) contains information and procedures necessary for base personnel to respond to disaster situations. The plan details the actions required to sustain and restore mission capability, provide for the welfare of affected personnel, and conduct emergency assistance with other military, Federal, and civil authorities.

Wake Island airfield also has in effect an Oil and Hazardous Substance Pollution Contingency Plan, dated June 1990 (USAFSC 1990), which provides guidance on procedures to be followed when responding to accidental spills of oil and other hazardous substances.

3.0 ENVIRONMENTAL CONSEQUENCES

3.0 ENVIRONMENTAL CONSEQUENCES

The analysis for identifying environmental consequences of the LEAP Test Program was conducted in the following phases. First, a determination was made whether an issue resulting from the proposed action is anticipated for any of the environmental media. Second, a determination was made as to whether or not the issue might lead to a significant impact. The impact is considered significant if it exceeds a particular media threshold; violation of a U.S. Army noise regulation is considered significant. It should be emphasized that the analysis assumes that standard engineering practices and mitigation measures are employed. For potentially significant impacts that still exist after employing standard engineering practices, planned mitigation measures are incorporated into the program. These would include, for example, using DOT approved drums for transporting the liquid bipropellants to minimize the safety risks associated with transporting hazardous materials.

For potentially significant impacts that are not mitigated as a result of the program's planned mitigation measures, analysis was then conducted in order to determine the environmental consequences associated with those impacts. These impacts were then reviewed to determine if they were mitigable to non-significant levels.

The analysis was first conducted on the LEAP technology. The purpose of this approach was to identify potential environmental issues associated with the technology that would exist irrespective of where a program activity is to take place. A site specific analysis was then conducted to identify other potential environmental issues associated with program activities at a specific location.

3.1 PROGRAM IMPACTS (Technology Analysis)

This section presents and assesses the technologies employed by the LEAP Program. The potential environmental impacts discussed are inherent to the technologies in use, regardless of geographic location. Technologies associated with LEAP include:

- Booster - M56A1 solid-fuel rocket motor;
- Flight Termination System (explosive device for mission abort) safe and arm system;
- M57A1 rocket motor (Two Rocket Launch Experiment only);
- Payload Module Bus containing ACS, cameras and telemetry equipment, STP, STP ejection mechanism, PMB cold gas propulsion and recovery package (parachute);
- Target reentry motor - Orbus-1, solid propellant;
- Target motor containing GN_2 cold-gas blowdown for separation;
- VIPER V - A solid-propellant meteorological rocket motor;
- Star 13C Kick Motor - A small solid-propellant rocket motor for the LEAP target;
- Space Test Projectile, containing cryogenically cooled HgCdTe sensors, beryllium mirror, and liquid bipropellant motor (N_2O_4/N_2H_4 or N_2O_4/MMH) for divert maneuvers;
- Free Flyer Observation Vehicle.

Potential Environmental Consequences

As a minimum, the technologies associated with routine launch operations have the potential to affect land use, geology and water resources, air quality, noise, biological resources, threatened and endangered species, cultural resources, infrastructure (of test locations), hazardous materials and wastes, and safety. Each of these areas were subject to analysis in order to determine the potential environmental issues that may result from application of LEAP technologies. Of the above-listed environmental media, only environmental issues associated with hazardous materials and waste, safety, and air quality were determined to be potentially significant.

3.1.1 Hazardous Materials and Wastes

Potentially significant impacts in the area of hazardous materials handling could occur due to the use of liquid fuels for the LEAP flights. Safety measures, as summarized in Section 1.2.4.3 will be implemented to limit impacts from the handling and disposal of these hazardous materials to insignificant levels. In the case of the LEAP launches, the bipropellants will be hydrazine or monomethylhydrazine and nitrogen tetroxide as an oxidizer. Hydrazine fuel is resistant to shock, making it a good fuel to use in a launch capacity. Storage temperature in the projectile should be controlled at approximately 35 degrees F to avoid freezing. Even if the hydrazine did freeze, the risk of structural damage would be minimal in that the hydrazine would contract rather than expand (Hughes,1990). Table 7 identifies the characteristics/hazards of LEAP liquid bipropellants and precautionary measures to be implemented during handling. For example, if containers leak vapors in confined spaces an explosive mixture could possibly occur.

3.1.2 Safety

Safety issues associated with the LEAP Program include shipment and handling of booster components and fuels, exposure to or inhalation of fuels or exhaust products, noise injuries, accidental explosion of the booster on the launch pad or immediately after launch, and debris from intercepts and reentry.

Booster components will be shipped from the western United States (mainly California, Utah, and Arizona) for final integration and checkout at a launch location. These components are of sizes and weights that can normally be handled by air and truck shipment. Solid stage motor (i.e., M56A1 and M57A1) components will be shipped using established procedures for pre-fueled solid rocket motors. Liquid fuel and oxidizer will be shipped separately using approved DOT containers and per DOT regulations for shipping hazardous materials. These operations have established procedures and are not anticipated to result in significant impacts.

TABLE 7

CHARACTERISTICS/HAZARDS OF LEAP LIQUID BIPROPELLANTS

BIPROPELLANT PHYSICAL PROPERTIES	EXPLOSIVITY/REACTIVITY FLAMMABILITY/FIRE	HEALTH HAZARD TOXICITY AND CORROSIVITY	PRECAUTIONARY MEASURES
NITROGEN TETROXIDE (OXIDIZER) (N_2O_4) BOILING POINT 70.1°F FREEZING POINT 11.8°F CRITICAL PRESSURE 1469 PSIA VAPOR PRESSURE 4.8 PSIA AT 30°F 14.5 PSIA AT 70°F 91.0 PSIA AT 150°F GENERAL APPEARANCE N_2O_4 IS A VOLATILE REDDISH BROWN LIQUID CONTAINING 70 PERCENT OXYGEN	CORROSIVE OXIDIZING AGENT, HYPERGOLIC WITH SEVERAL FUELS INCLUDING HYDRAZINE SPILL. PRESENTS AN EXPLOSION HAZARD PARTICULARLY AT ELEVATED TEMPERATURES OR IMPACT. CONTAINERS IN PROXIMITY TO A FIRE MAY PRESSURE RUPTURE IF CONTAINERS LEAK VAPORS CAN FORM EXPLOSIVE MIXTURE ESPECIALLY IN CONFINED SPACES. MIXTURES OF N_2O_4 ARE HEAT PLUS SHOCK SENSITIVE (EXPLODES) IN CONTACT WITH HALOGENATED HYDROCARBONS N_2O_4 WILL REACT EXPLOSIVELY WITH ETHYLENE GLYCOL COMPATIBILITY WITH MATERIALS (SEE TABLE 3-3) MILITARY GROUP HAZARD GROUP 1, COMPATIBILITY GROUP A.	HIGH TOXICITY TLV* 1.0 PPM HIGHLY CORROSIVE DESTROYS BODY TISSUES, SEVERE BURNS OF SKIN AND EYES, CYANOSIS, PULMONARY EDEMA, EMPHYSEMA	PERSONNEL MUST BE TRAINED IN THE HANDLING OF SYSTEMS CONTAINING N_2O_4 AND SAFETY MEASURES RELATING TO PROTECTIVE CLOTHING EQUIPMENT AND DISPOSAL. A DETECTION AND ALARM SYSTEM SHOULD BE PROVIDED TO WARN PERSONNEL WHEN THE CONCENTRATION OF N_2O_4 VAPORS EXCEEDS THE TLV. AT LEAST TWO PEOPLE SHOULD BE ASSIGNED TO ANY OPERATION RELATING TO THE HANDLING, TRANSFER AND STORAGE OF N_2O_4. IF A SPILL OCCURS OR A FIRE STARTS, FIGHT IT WITH WATER TO CONTROL IT. USE SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING BEFORE ENTERING THE SPILL AREA. SMALL QUANTITIES (SUCH AS CONTAINED IN LEAP) CAN BE DISPOSED OF BY PERMITTING EVAPORATION INTO THE ATMOSPHERE.
HYDRAZINE (N_2H_4) 97.5 PERCENT N_2H_4 2.5 PERCENT H_2O (MIL-P-26536) BOILING POINT 38.3°F FREEZING POINT 35°F CRITICAL PRESSURE 2135 PSIA CRITICAL TEMP. 716°F VAPOR PRESSURE 0.07 PSIA AT 40°F 0.31 PSIA AT 80° 2.0 PSIA AT 160°F FLASH POINT OPEN CUP 125.6°F AUTOIGNITION TEMPERATURE 518°F FLAMMABILITY RANGE IN AIR BY VOLUME IN AIR AT 1 ATMOSPHERE 4.7 TO 100 PERCENT DECOMPOSITION BEGINS AT ABOUT 320°F SLOW DECOMPOSITION MAY OCCUR AS A RESULT OF CONTAMINATION REACTION WITH TANK MATERIALS BUT OVER A VERY LONG STORAGE TIME PERIOD. DECOMPOSITION PRODUCTS ARE H_2, N_2 AND NH_3 GENERAL APPEARANCE CLEAR, OILY, WATER WHITE LIQUID WITH AN ODOR SIMILAR TO AMMONIA	EXPOSURE TO AIR FROM A LARGE SURFACE MAY RESULT IN SPONTANEOUS IGNITION BECAUSE OF HEAT EVOLVED FROM OXIDATION WITH ATMOSPHERIC OXYGEN FILM OF N_2H_4. IN CONTACT WITH METALLIC OXIDES OR OTHER OXIDIZING AGENTS MAY IGNITE SPONTANEOUSLY. MMH IS HYPERGOLIC WITH N_2H_4 DECOMPOSES EXOTHERMALLY (MAY IGNITE) ON CONTACT WITH SOME METALS INCLUDING IRON, COPPER, PLATINUM, MOLYBDENUM, AND THEIR ALLOYS AND OXIDES (SEE TABLE 3-3 FOR LIST OF COMPATIBLE MATERIALS) N_2H_4 IS CLASSIFIED AS MILITARY HAZARD GROUP III AND STORAGE COMPATIBILITY GROUP C. THE LIQUID IS NOT SENSITIVE TO IMPACT OR FRICTION. VAPORS IN CONCENTRATION WITHIN THE FLAMMABILITY RANGE CAN EASILY BE EXPLODED BY SPARK OR OPEN FLAME. TEST DATA INDICATES THAT PURE HYDRAZINE CONTAINING SATURATED HYDRAZINE VAPOR BUBBLES WOULD NOT DETONATE AT 150,000 G.	HIGH TOXICITY TLV 2 PPM VOLATILE CAUSTIC LIQUID IRRITATING TO SKIN AND PULMONARY TRACT. CAN CAUSE SYSTEMIC TOXICITY THROUGH SKIN ABSORPTION OR INHALATION. SYSTEMIC EFFECT INVOLVES CENTRAL NERVOUS SYSTEM, DAMAGE TO LIVER, KIDNEYS, AND ANEMIA.	PERSONNEL MUST BE TRAINED IN THE HANDLING OF SYSTEMS CONTAINING MMH AND SAFETY MEASURES RELATING TO PROTECTIVE CLOTHING EQUIPMENT AND DISPOSAL. A DETECTION AND ALARM SYSTEM SHOULD BE PROVIDED TO WARN PERSONNEL WHEN THE MMH VAPOR CONCENTRATION EXCEEDS THE TLV. AT LEAST TWO PEOPLE SHOULD BE ASSIGNED TO ANY OPERATION RELATING TO THE HANDLING, TRANSFER AND STORAGE OF MMH. IF A SPILL OCCURS SMALL QUANTITIES (SUCH AS CONTAINED IN LEAP) CAN BE COLLECTED IN A BASIN AD REACTED WITH 10 PERCENT HYDROGEN PEROXIDE OR CALCIUM HYPOCHLORITE FOR OXIDIZER SUPPORTED FIRES WATER FROM A SPRAY IS EFFECTIVE.
MONOMETHYLHYDRAZINE (MMH) BOILING POINT 189.5°F FREEZING POINT -65°F CRITICAL PRESSURE 1194 PSIA CRITICAL TEMPERATURE 593.6°F VAPOR PRESSURE 0.31 PSIA AT 40°F 1.0 PSIA AT 80° 3.1 PSIA AT 120°F 7.9 PSIA AT 160°F FLASH POINT OPEN CUP 34°F AUTOIGNITION TEMPERATURE 382°F FLAMMABILITY RANGE IN AIR BY VOLUME IN AIR AT 1 ATMOSPHERE 2.5 TO 98 PERCENT	EXPOSURE TO AIR FROM A LARGE SURFACE MAY RESULT IN SPONTANEOUS IGNITION. A FILM OF MMH IN CONTACT WITH METALLIC OXIDES OR OTHER OXIDIZING AGENTS MAY IGNITE SPONTANEOUSLY. MMH DECOMPOSES ON CONTACT WITH SOME METALS INCLUDING IRON, COPPER, PLATINUM, MOLYBDENUM, AND THEIR ALLOYS AND OXIDES. VAPORS CAN BE EXPLODED BY ELECTRIC SPARK OR OPEN FLAME. DUE TO HIGH VAPOR PRESSURE AND A WIDE FLAMMABILITY RANGE, THE POSSIBILITY OF AN EXPLOSIVE MIXTURE FORMING OVER UDMH OR MAF IS VERY HIGH.	HIGH TOXICITY TLV* 1.0 PPM VOLATILE CAUSTIC LIQUID IRRITATING TO SKIN AND PULMONARY TRACT. CAN CAUSE SYSTEMIC TOXICITY THROUGH SKIN ABSORPTION OR INHALATION. SYSTEMIC EFFECT INVOLVES CENTRAL NERVOUS SYSTEM, DAMAGE TO LIVER, KIDNEYS, AND ANEMIA.	PERSONNEL MUST BE TRAINED IN THE HANDLING OF SYSTEMS CONTAINING MMH AND SAFETY MEASURES RELATING TO PROTECTIVE CLOTHING EQUIPMENT AND DISPOSAL. A DETECTION AND ALARM SYSTEM SHOULD BE PROVIDED TO WARN PERSONNEL WHEN THE MMH VAPOR CONCENTRATION EXCEEDS THE TLV. AT LEAST TWO PEOPLE SHOULD BE ASSIGNED TO ANY OPERATION RELATING TO THE HANDLING, TRANSFER AND STORAGE OF MMH. IF A SPILL OCCURS SMALL QUANTITIES (SUCH AS CONTAINED IN LEAP) CAN BE COLLECTED IN A BASIN AD REACTED WITH 10 PERCENT HYDROGEN PEROXIDE OR CALCIUM HYPOCHLORITE FOR OXIDIZER SUPPORTED FIRES WATER FROM A SPRAY IS EFFECTIVE.
*TLV THRESHOLD LIMIT VALUE			

SOURCE: LEAP SYSTEM SAFETY HAZARD ANALYSIS REPORT, HUGHES AIRCRAFT COMPANY, 1990; AL, 1990.

Various safety precautions, such as those outlined in the LEAP System Safety Hazard Analysis Report, will be taken to prevent and mitigate potential impacts from an accident. Facilities will be monitored by the host installation safety officer for safety violations and hazards, which, if found would be immediately corrected. Medical and firefighting personnel will be available for emergency response. Facilities where explosion or fire could occur will be equipped with fire hoses and extinguishers. Facilities that could experience the release of colorless and odorless gases will be equipped with detectors to sense a dangerous condition and alert the area via visible and audible signals. Whenever hazardous operations might occur, a safety zone is established in advance and noninvolved persons will be dismissed from the area. All persons assigned to duties that could require them to encounter a hazardous situation will be trained in the use of safety equipment and be familiar with escape routes and procedures.

A System Safety Hazard Analysis Report (HUGHES, 1990) was prepared to identify design and operational critical and catastrophic hazards associated with the LEAP Program. The analysis examined over 70 system operation events from the handling and installation of the STP projectile to hover test effects on actuators for cryo, helium and vacuum lines. All events were examined for the potential hazard mode and the hazard effect on the overall system. All events were rated for hazard severity from negligible to catastrophic and for likelihood from impossible to frequent. The analysis found no unacceptable risks associated with the LEAP Program (unacceptable being rated, at a minimum, as catastrophic/remote, critical/occasional, marginal/probable, or marginal/ frequent occurrence).

3.1.3 Air Quality

The pollutants of concern for LEAP launches, in a bounding case scenario (launch pad explosion), are carbon monoxide, nitrogen dioxide, particulate matter (aluminum oxide), and hydrochloric acid (HC1).

The other constituents of launch exhaust, although known to produce human health effects in high concentrations, do not persist at lethal concentrations long enough to generate an

impact. The most persistent component of launch emissions is aluminum oxide (Al_2O_3), which is formed as a particulate solid, but direct environmental damage from this compound directly related to launch activities has not been documented.

A primary air quality issue associated with the Aries booster is hydrogen chloride (HCl) and its potential impacts to vegetation and surface waters. HCl impacts from rocket launches have been addressed for large rockets such as the Space Shuttle and Titan IV launch vehicles (Dreschel and Hall, 1985; Dreschel and Hall, 1990; USAF, 1990 among others). The effects of smaller rockets, such as the LEAP launch vehicle, have been addressed by scaling the available data from the large rockets to determine that for small vehicles, insignificant amounts (orders of magnitudes less) of HCl are generated and deposited in the near-field (radius of 0.5 kilometers from the launch pad centerline).

The Space Shuttle generates approximately 17,000 kg. of HCl per launch from the two, large solid rocket motors during the first 10 seconds of a launch (Dreschel and Hall, 1990). HCl generated at ignition and close to the ground surface is contained as part of the ground exhaust cloud. In addition, both Space Shuttle and Titan IV launches use a water deluge system to suppress rocket vibration during lift-off. The interaction of the water deluge with the heat of motor ignition generates water vapor, which entrains the HCl within the cloud and increases its reactivity with the surrounding environment.

The amount of HCl deposited by the Space Shuttle in the near-field has been estimated to be approximately 3000 kilograms per launch, with an average concentration of 100 gm/m^2 (Schmalzer et al, 1985). HCl deposition in the far-field environment (greater than 0.5 kilometers from the launch pad centerline) ranged from 25 gm/m^2 to 5,300 gm/m^2 (Schmalzer et al, 1986). The environment surrounding the Space Shuttle and Titan IV launch vehicles at Cape Canaveral Air Force Station (CCAFS) may be described as a marine-influenced system, since it is a coastal barrier island, with high humidity, sea breezes and both marine and freshwater surface water sources. Although some damage to vegetation within the near-field has occurred with all Space Shuttle launches examined in the 1985 study, the highest incident of damage occurred when the humidity was high (70

to 95 percent). Minor damage (leaf spotting with an average density of 6800 spots/m^2) to sensitive vegetation in the far-field occurred at HCl concentrations ranging from 25 to 33 gm/m^2 (Schmalzer et al, 1986). In a 1984 review paper on the effects of acidic deposition on terrestrial vegetation (Evans, 1984), it was noted that acidic effects are much more pronounced when the deposition was wet, and the degree of damage was also related to the ability of the vegetative surface to hold water. This is also supported in work on the Space Shuttle deposition of HCl (Schmalzer et al, 1985 and references cited therein).

HCl impacts to surface water resources by the Space Shuttle have been limited to isolated fresh water sources within the near field. The surrounding marine environment is not impacted due to the buffering capabilities of the naturally occurring sea salts.

The LEAP launch vehicle generates a total of 680.4 kg. of HCl along the entire motor burn trajectory (both first and second stages). Under a bounding case scenario, that of an explosion of the vehicle on the launch pad with a complete release of HCl at ground level, and complete deposition of the entire 680.4 kg of HCl within a 22.5 degree sector with a radius of 0.5 kilometer, results in an average deposition of approximately 7 gm/m^2. As there is no water deluge system associated with LEAP launches, deposition of HCl would be limited to dry particles, which are much less reactive, or damaging to surrounding surfaces.

3.2 SITE SPECIFIC ANALYSIS COMPONENT/ASSEMBLY GROUND TEST LOCATIONS

As previously noted, interviews were conducted with participants in the LEAP project. During these interviews, the compatibility of LEAP associated technologies and the existing activities and environment at the various facilities were addressed.

3.2.1 Boeing Aerospace & Electronics (BAE), Kent, Washington

No modification of the existing facility or the expansion of the staff via the hiring of new employees will take place as neither is necessary. All work done with respect to LEAP is within the realm of other activities performed at BAE and is, therefore, considered routine. The environmental management group at BAE conducts environmental audits on an ongoing basis to ensure compliance with environmental laws and regulations. As indicated in Section 2.1.1., no significant environmental issues are present at the BAE facility; therefore, no significant environmental impacts are expected.

3.2.2 Hughes Aircraft Company, Missile Systems Group, Canoga Park, California

Testing of components will take place in Hughes testing facilities, Phillips Laboratory and the facilities of subcontractors which will be producing and testing the propulsion system. All tests will be done in existing facilities which do not require modification, and do not require the hiring of additional personnel. For these reasons, no significant environmental impacts are expected as a result of the proposed action.

3.2.3 Space Data Division (SDD), Orbital Sciences Corporation, Chandler, Arizona

Component and assembly checkout tests of the booster interstage, target, PMB and the projectile will be performed by SDD at its Chandler, Arizona facility. These types of tests and activities are within the normal scope of operations routinely conducted at the SDD facilities. No additional personnel or facilities will be required to perform these tests. As noted, no significant issues have been identified at the facility; therefore no significant environmental impacts are expected.

3.2.4 Phillips Laboratory, Edwards AFB, California

Phillips Laboratory is responsible for acquisition and integration of LEAP flight and flight support hardware. Phillips' role is primarily supervisory, making sure that all processes are

done in accordance with the U.S. Air Force and state health and safety regulations. These tests and activities are within the normal scope of activities routinely conducted at Phillips, and no additional personnel will be required. Environmental documentation has been prepared for hover and strap down testing (Phillips, 1990) and additional exemptions from the Kern County Air Quality Control District have been obtained (Paxson, 1990). No significant environmental impacts are expected.

3.3 SITE SPECIFIC ANALYSIS PREFLIGHT AND FLIGHT TEST LOCATIONS

As identified in Section 1.2.2.1, construction of a new integration facility will be required to support LEAP activities. The construction will occur on a previously graded and disturbed area. Additionally, no relocation of utility sources will be required. Therefore, no significant impacts are expected as a result of the proposed action.

Four flights are scheduled for the LEAP Test Program at WSMR. Two additional flights are scheduled at USAKA. All will use the rocket technologies described in this EA and would be launched from either WSMR, USAKA, or Wake Island.

3.3.1 <u>WSMR</u>

In order to minimize potential effects on the WSMR environment, LEAP launches will operate within operational criteria of on-going launch activities at the range.

3.3.1.1 Physical Setting and Land Use

Physical setting and land use environmental considerations include potential effects on the socioeconomic environment. Land use considerations include the present use and condition of the launch site and adjoining lands, proposed alterations to the use, and potential conflicts with adjacent uses. Impacts due to the launching of the LEAP vehicles could include soil contamination, soil erosion, and interference with the use of adjoining land.

Impacts to land use from component/assembly ground test operations area not anticipated. This is because existing buildings and facilities will be used for all these activities.

Land use will be affected through implementation of the Safety Plan for launches at WSMR. This will include evacuation of non-essential personnel in the launch and impact areas and establishment of internal roadblocks required to ensure the integrity of the evacuation area. US Highway 70 will also be blocked during the launch. The highway will be closed for less than one hour and the practice is routine at WSMR. Therefore, no significant impacts will occur.

3.3.1.2 Geology and Water Resources

As described in Section 1.2, no construction is be required for the LEAP Progr ım at WSMR, thereby eliminating construction impacts on the local geology at LC 36 ar d Sulf Site launch sites. The lack of surface water ir these areas also precludes impacts to surface water resources during vehicle assembly, checkout, and launch.

Launch trajectories for LEAP will result in the spent booster, PMB, target boost assist module, shroud, and target (both with or without enabling of the re-entry motor) landing in the dispersion areas shown in Figure 7. Surface water resources in these areas include Salt Creek and Malpais Spring, which are habitat for the White sands pupfish. Recovery activities associated with LEAP are planned to avoid impacts to those resources because damage to the habitat would potentially affect the pupfish. As previously indicated, LEAP launches are expected to nominally produce only 5 pieces of debris that will survive re-entry and impact on WSMR.

The potential impacts of a piece of debris striking and killing a White Sands pupfish or its habitat must be examined in terms of the impact to the continuation of the population, not the impact to a single individual. The White Sands pupfish, although occurring in a very restricted environment, is fairly abundant within that restricted area. The impact of a piece of debris landing within a creek or stream bed occupied by pupfish would be the short-

term impact to the individuals occurring in that area, and potential long-term impact if the stream bed was altered beyond its ability to support pupfish. However, pupfish upstream of the impact area would continue to thrive, and assuming that the impact was restricted to the immediate area of the debris, pupfish downstream of the area may also be expected to thrive as long as water flows were still available. Given the transient nature of stream bed flows, it is reasonable to expect that during the rainy season, any disruption to the stream bed would be compensated for by the creation of a new channel or connection to downstream areas. Downstream impacts would be most severe at the beginning of the dry season.

Given the above analysis, no significant impacts to geology or water resources are expected. If, however, any damage to species habitat occurred as a result of rocket debris, restoration to a pre-impact condition will be implemented.

3.3.1.3 Air Quality

The air modeling analysis for WSMR flights is separated into two categories: first, analysis for emissions from a normal launch scenario; and second, analysis of a launch accident scenario. For the normal launch scenario, the analysis was conducted on the emissions produced by an M56A1 rocket motor which is the propulsion source for the Aries I booster used at WSMR. For the accident scenario, both the M56A1 and M57A1 were included in the analysis in order to achieve the most conservative estimate.

These solid-fuel rocket motors emit water (H_2O), carbon dioxide (CO_2), carbon monoxide (CO), nitrogen (N_2), hydrogen (H_2), aluminum oxide (Al_2O_3) and hydrogen chloride (HCl). Of these primary emission constituents, only carbon monoxide and aluminum oxide are regulated air pollutants under National Ambient Air Quality Standards. Aluminum oxide is emitted as a particulate and is therefore compared to the PM-10 standard. Air pollutant emissions during the Aries I (M56A1) rocket launch solid-fuel combustion total approximately 10,370 pounds (Appendix B, Table 1).

A routine launch of an Aries I would involve a successful lift off from a launch pad. Since the Aries I rocket will be under constant acceleration, more of the exhaust will be emitted in the initial near ground portion of the flight. However, exhaust temperatures will cause the pollutants to rise and disperse. To account for the maximum release of pollutants, the accidental release scenario is associated with a launch pad detonation of an Aries booster. Estimates of ground level concentrations of pollutants resulting from the routine LEAP launch scenario and accident scenario were developed using a quasi-instantaneous PUFF transport and dispersion model.

To provide an estimate of the prevailing surface wind directions at WSMR, meteorological data from Albuquerque, New Mexico was used. Based on these data the prevailing surface wind direction at WSMR on an annual basis should be from the Southeast. Should the El Paso, Texas meteorological data be more representative of WSMR, the prevailing annual winds would be from the North. Much variation in the monthly prevailing wind direction occurs at these stations.

Because the site wind directions during an operational launch or accident are dependent on the time of year and time of day, it is not possible to estimate expected wind directions during a launch. This is especially true as the wind direction changes with altitude. To account for this unknown and to provide concentrations that would be larger than expected, the dispersion analysis provided was made independent of wind direction. It was assumed that the wind blows in constant direction for the duration of the averaging period of concern.

The analysis of air quality impact for the normal and accidental launch of the LEAP vehicle was performed under release and atmospheric conditions that were:

1) Conservative - Values that should provide concentrations that are higher than expected.

2) Bounding-case - Values that should provide concentrations that will not be exceeded.

The results of the conservative analysis for both the normal and accident release scenarios revealed concentrations much less than the applicable ambient air quality standards, threshold limit values, and permissible exposure limits. The results of the bounding-case analysis of both normal and accident launch scenarios revealed carbon monoxide, nitrogen dioxide, and particulate concentrations exceeding guideline values at distances less than 1 km from the release. However, the bounding case analysis was only performed to provide upper bound concentrations to demonstrate the small impact expected from LEAP launches under very implausible conditions, and therefore do not warrant further impact assessment.

The American Conference of Government Industrial Hygienists (ACGIH) and the Occupational Safety and Health Administration (OSHA) guideline standards were used as comparison values in the analysis of impact. (See Table 5, Appendix B) The most stringent short-term guideline values were the controlling concentrations in the comparison analysis. Tables 3, 4, 6 and 7 in Appendix B provide the estimated concentrations and the controlling guideline values.

The immediately dangerous life or health (IDLH) concentrations are provided in Table 6. These concentration levels for the applicable LEAP pollutants are:

Pollutant	IDLH
Aluminum Oxide	--
Carbon Monoxide	1,500 ppm
Carbon Dioxide	50,000 ppm
Nitrogen Dioxide	50 ppm
Hydrogen Chloride	100 ppm
Particulate Matter	--
Nitric Oxide	100 ppm

The IDLH concentrations are larger (less stringent) than the air quality guideline values used in impact comparison analysis.

Exceedances of applicable standards only occur under the bounding case scenario (see Appendix B). Exceedances of these standards do not occur under the far more likely conservative analysis. The magnitude of the releases, the area over which the pollutants are initially dispersed, and the buoyant nature of exhaust products all contribute to the small magnitude of the expected ground level impact.

The bounding case scenario includes certain assumptions which are very unlikely. For example, the exhaust cloud is assumed to rise 0 meters in the bounding case analysis, 100 meters in the conservative analysis, and realisitically is expected to rise over 300 meters. Given the unlikely circumstances under which small exceedances in air quality standards would occur, no significant impacts to air quality are expected as a result of LEAP test flights.

In an arid environment, such as White Sands Missile Range, the effects of HCl deposition from the Aries booster on the surrounding area would be virtually undetectable. There are no freshwater surface water sources within 0.5 kilometers of either LC 36 or the Sulf launch sites that would be potentially impacted by HCl deposition. In addition, the presence of minerals such as gypsum would have a neutralizing effect on HCl deposited in the surrounding soils.

Based on small quantities of HCl generated at WSMR, the state of HCl deposition (dry versus wet), and the climatology and general environmental factors of WSMR, significant HCl impacts to surrounding vegetation or surface waters are not anticipated.

3.3.1.4 Noise

The levels of significance identified in Section 2.2.1.4 described "absolute" noise significance impacts. Humans, however, are also sensitive to sudden changes in noise levels. A "relative" criteria is used to qualify the negative impacts of changes in noise levels associated with the proposed launches. Sudden changes of ambient levels greater than 35 dBA can startle or frighten humans and animals. For this reason, changes of greater than 35 dBA are considered significant. This criteria, which has been used for similar DoD studies at WSMR and other sites, is based on the individual. Since each 10 dB increase is perceived as a doubling of loudness by the human ear, an increase of 35 dB represents a reasonable secondary threshold for noise nuisance.

A noise monitoring study was conducted at WSMR in January, 1990. The noise study report entitled, HEDI KITE I Noise Monitoring Technical Report, contains measured rocket and ambient noise levels, as well as noise propagation information. The results of this study are used for the noise assessment of the LEAP launches.

Each of the proposed LEAP launches at WSMR will utilize Aries rockets. Since no noise data are available on the Aries rocket, data are extrapolated from the monitor information on Sprint type booster rockets contained in the HEDI report. The Sprint rocket booster contains approximately 3,870 pounds mass (lbm) of propellent discharged (burned) in 1.5 seconds, resulting in a burn rate of 2580 lbm per second (lbm/sec). The Aries booster rocket contains 10,370 lbm of propellent discharged in 63 seconds, resulting in a burn rate of 165 lbm/sec.

By comparing size, fuel, and noise frequency spectra between the Aries and Sprint rockets, it is possible to estimate a decibel relationship in their respective burn rates. This comparison results in the finding that the Sprint rocket produces approximately 12 dB more than the Aries.

The HEDI noise study reported measured noise levels for the Sprint booster rockets at a distance of 1000 feet using a variety of noise descriptors. These levels are presented in Table 8 along with the corresponding adjusted estimates for the Aries booster. The launch pad area background noise level, extrapolated from the statistical breakdown of the HEDI measured noise data, is assumed to be approximately 35 dBA.

With the measured sound pressure level known, resulting sound power estimates for the Aries rocket were made. The sound power level of the Sprint booster is estimated to be 172 dB sound power level (PWL). The sound power level of the Aries booster is estimated at 160 dB PWL.

Based on the estimated sound power level of an Aries booster, noise levels at various distances from the launch pad were calculated. Estimates were made for exterior and interior noise levels at locations within WSMR as identified below:

TABLE 8

PRODUCED NOISE LEVELS

NOISE RECEPTOR	PROJECTED SPL AT RECEPTOR			
	DISTANCE	EXTERIOR	INTERIOR OPEN*	INTERIOR CLOSED**
Post Area	53000 ft	68 dBA	58 dBA	43 dBA
San Andres National Wildlife Refuge	63000 ft	66 dBA	N/A	N/A

* OPEN - Interior noise levels assuming open windows.
** CLOSED - Interior noise levels assuming closed windows.

Source: DMSS, 1990.

As indicated in Table 8, project related launches should have no significant noise impacts on the hearing conservation of personnel working in the post area. Launch induced exterior

noise levels are not expected to exceed the OSHA recommended criteria limit of 115 dBA for 15 minutes.

Personnel positioned closer to the launch pad than the evaluated receptors would be subject to greater noise levels. Hearing protection equipment such as insert soft ear plugs and/or exterior noise reducing ear muffs, with accompanying detailed instruction on proper application, should be issued to such personnel to provide protection against these noise levels.

Impacts on Desert Bighorn Sheep

Noise levels within the San Andres National Wildlife Refuge have been calculated to assess potential project related noise impacts on the indigenous desert bighorn sheep (Ovis canadensis) population. The bighorn sheep are a designated endangered species by the State of New Mexico. Concern has been expressed that elevated noise levels may stress the herd. Noise levels presented in Table 8 represent maximum produced noise levels projections for the nearest point in the Refuge to LC 36 (approximately 12 miles).

The "dBA" noise descriptor is intended to simulate the human frequency perception of sound. Frequency sensitivity of big horn sheep is unknown, and little data exists concerning noise impacts on bighorn herds. Similarities in the physical size of human and bighorn sheep auditory systems may suggest that sheep hearing is comparable to human hearing. For these reasons, the dBA descriptor is used to evaluate potential impacts on the desert bighorn sheep population. The HEDI study project at WSMR concluded that launches of Sprint vehicles, which are louder than the Aries, produced lower noise levels in the area of critical habitat for the threatened desert bighorn sheep (San Andres Mountains) than noise from wind or aircraft overflights (USASDC, 1989b). Based on the above conclusions, it is unlikely the expected noise levels from LEAP flights will cause physical or stress-related damage to the bighorn sheep.

The study documented existing background ambient noise levels at 35 dBA for the area adjacent to LC 36 and the San Andres NWR. The results presented in Table 8 indicate that the maximum noise level in the NWR would be approximately 66 dBA during an Aries booster launch. This represents an estimated 31 dBA increase over background noise levels, which is below the relative noise criteria limit of a 35 dBA sudden increase above the baseline noise levels. Therefore, it is not expected that the launch of Aries boosters will significantly impact or stress the endangered desert bighorn sheep herd in the San Andreas NWR.

3.3.1.5 Biological Resources

Potential impacts to species other than those designated as threatened or endangered from the LEAP Program may occur from launch debris, noise or recovery of the payload module bus and spent stages. Fires ignited by falling debris that may affect plants or wildlife are considered to be not significant due to the WSMR fire response unit that normally contains the small fires occasionally caused by falling debris and the few number of fragments expected. In the unlikely event of a flight termination, the possibility exists that the canister containing the liquid propellants would rupture on impact, releasing its contents. Due to the hypergolic nature of the propellants, a fire would occur, but the small amount of propellants would be rapidly consumed.

Debris produced by the LEAP flights includes the spent boosters, PMB, target, Target Boost Assist Module, and shroud. The PMB will come down on a parachute, reducing its impact velocity. The potential impact of the remaining debris on vegetation at the landing point is not considered to be significant due to the minor amount of debris. There is an extremely remote possibility that local wildlife will be disturbed or harmed by falling debris. This impact is considered to be not significant, due to both the very low potential for a piece of debris to actually strike an individual animal and the abundance of non-threatened wildlife populations. The potential removal of a single individual would not impact the continued viability of populations not designated as threatened or endangered.

Potential impacts from debris recovery will be minimized due to the implementation of the mitigation measures outlined in Section 1.2.6 as part of the LEAP Test Program.

3.3.1.6 Threatened and Endangered Species

Potential impacts to threatened or endangered plants or animals at LC 36 or the Sulf Site are not considered to be significant. This is based on site surveys conducted for HEDI KITE and EXCEDE III programs (USASDC, 1989b; NOMTS, 1990), which did not find threatened or endangered species in the vicinity of the launch facilities, and that no new construction or activities are proposed for these sites.

The potential impacts from debris directly hitting a species or affecting the potential suitable habitat of a species were analyzed, in response to consultation with the USFWS, for the following species: Aplomado Falcon, Todsen's pennyroyal, White Sands pupfish and the desert bighorn sheep.

Aplomado Falcon (Federal Endangered)

The Aplomado Falcon is officially not known to inhabit New Mexico. This species is not known to occur on WSMR, therefore the potential impact of the LEAP test program is not significant.

Todsen's Pennyroyal (Federal Endangered)

The Todsen's pennyroyal is known to occur on WSMR in Rhodes Canyon. Its preferred habitat is gravelly gypsum limestone soils, on steep north- or east-facing slopes at an elevation above 6,000 ft., and under pinyon-juniper overstories. Data sources, the Soil Survey of WSMR and USGS Quadrangle maps, were examined to determine potential suitable habitat for the Todsen's pennyroyal.

The Soil Survey of the White Sands Missile Range indicates that the Deama (Do) and Rock land - cool, (RK) soils are steep gravelly limestone/gypsum soils which also occur within the Pinyon-Juniper zone of the San Andres Mountains. The USGS Quadrangles indicates the presence of Pinyon-Juniper generally above elevation 6000 ft. and favoring the north and east slopes within the San Andres Mountains.

The three characteristics that appear to contribute to potentially favorable habitat for _H. todsenii_ (soils, slope direction, overstory) were superimposed on the appropriate USGS Quads of the area. Lands within the Pinyon-Juniper zone of the San Andres Mountains on north and east aspect steep slopes underlain by Deama and Rock land-cool soils were considered to be potential suitable habitats for the _H. todsenii_ and were delineated onto the USGS Quadrangle maps in the area which could contain the LEAP debris.

The dispersion areas of the four LEAP launches were superimposed on the potential suitable habitat of the Todsen's pennyroyal. Only the dispersion areas of LEAP 1 and 2 were found to coincide with potential habitat of this species. The area of coincidence is marginal habitat east of Mount Baldy totalling approximately 25 acres. The known occurrence of the Todsen's pennyroyal on WSMR is approximately 6.4 miles from the closest edge of the debris dispersion area.

A probability analysis of debris landing within the potential suitable habitat of the pennyroyal was conducted. The methodology used for the analysis is Mathematical computation of probabilities using the formula:

$$P = \frac{I_p \times D_p \times S_p}{S_t}$$

where:

P is the probability of debris landing in potential suitable Todsen's pennyroyal habitat.

I_p is the probability of debris landing within the debris dispersion area (0.997),

D_p is the number of pieces of debris of sufficient mass to potentially cause damage (1),

S_p is the surface area of potential habitat within the debris dispersion area (1,125,000 square feet),

S_t is the total surface area of the debris dispersion area (1,031,473,0[illegible] square feet).

The probability of debris from each LEAP experiment landing in the potential suitable habitat of the pennyroyal is 0.0011. This means that there are 11 chances in 10,000 that a piece of LEAP debris will land within the potential suitable habitat from the first or second LEAP flights for a total probability of 22 chances in 10,000. It should be noted that this is marginal habitat east of Mount Baldy and 6.4 miles from the known occurrence of the species.

The potential impacts of debris landing on potential suitable habitat is minimal. In addition, several mitigation measures will be implemented to reduce the potential impact of disturbance of habitat during debris recovery operations and/or that caused by brush fires. These mitigation measures are discussed in Section 1 as part of the LEAP Test Program. With these mitigation measures in place, the potential impacts to the Todsen's pennyroyal are not significant.

- White Sands Pupfish (state - Endangered; Federal candidate)

The White Sands pupfish is found in Malpais Spring and Lost River, Otero County; Salt Creek, Sierra County; Mound Springs, Lincoln County; and Malpais Spring area within the debris dispersion areas of the third and fourth LEAP test flights.

Should debris from the LEAP program land in Salt Creek or Malpais Spring the potential for damage exists. An analysis was conducted to set the upper limit for the probability of debris landing in Salt Creek or Malpais Spring. The methodology used for the analysis is similar to that used for the Todsen's pennyroyal. The mathematical formula is:

$$P = \frac{I_p \times D_p \times S_p}{S_t}$$

where:

P is the probability of debris landing in Salt Creek,

I_p is the probability of debris landing within the debris dispersion area (0.997),

D_p is the number of pieces of debris of sufficient mass to potentially cause damage (1),

S_p is the surface area of potential habitat within the debris dispersion area,

S_t is the surface area of the debris dispersion area.

Only the third and fourth LEAP flights have the potential of affecting pupfish habitat. The results are presented for each LEAP flight separately and the cumulative of all flights.

<u>LEAP 3</u> - three pieces of debris have dispersion areas wich infringe on the potential habitat of the pupfish. The probability of the TBAM landing in Salt Creek or Malpais Spring is 4.9 chances in 10,000. The probability of the LEAP 3 booster landing within Salt Creek is 3.1 chances in 10,000. The PMB has the same dispersion area as the booster, therefore the probability of the PMB landing in Salt Creek is 3.1. chances in 10,000. The total probability of debris from the LEAP 3 test flight landing in habitat of concern is 11 chances in 10,000.

<u>LEAP 4</u> - two pieces of debris have footprints which infringe onto Salt Creek. The shroud of LEAP 4 has 4.2 chances in 10,000 of landing within Salt Creek. The PMB has a probability of 3.9 chances in 10,000 of hitting somewhere along Salt Creek. The total probability of debris from LEAP 4 hitting Salt Creek is 8.1 chances in 10,000.

Using the cumulative properties of probabilities, the probablility of any piece of debris from any of the LEAP flights landing within the width of Salt Creek or Malpais Spring was determined to be 19 chances in 10,000.

The potential impacts of debris landing into the habitat of the White Sands pupfish is miminal. Mitigation measures are incorporated in the LEAP Test Program to prevent impacts to the critial habitat of the pupfish. These measures are discussed in Section 1.2.6.

With these mitigation measures in place, the potential impacts of the LEAP Test Proram on the White Sands pupfish are not significant.

Desert Bighorn Sheep

A population of desert bighorn sheep (state Endangered) is found in the San Andres Mountains. This is the last resident, indigenous population of desert bighorns in the state of New Mexico. There are approximately 25 -30 animals left in two or three herds. The majority of the animals are located in the San Andres National Wildlife Refuge. A small population of approximately 9 animals, representing one-third of the herd, are located at Strawberry Peak north of the Refuge.

A probability analysis was conducted to predict the chances of a desert bighorn sheep being hit by debris from the LEAP test program. The methodology used for the analysis is mathematical computation of probability using the formula,

$$P = \frac{\text{total debris x size of sheep}}{\text{size of debris impact area}}$$

where:

P = the probability of debris hitting a sheep,

Total debris = the probability of debris landing within the debris dispersion area times the number of pieces of debris predicted to land within that area (0.997),

Size of Sheep = the estimated two dimensional surface area of a Desert Bighorn Sheep as viewed from above (5 square feet),

Size of debris impact area = the surface area of the predicted debris impact area.

The results are presented for each LEAP flight experiment and the cumulative of all flights.

LEAP 1 - two pieces of debris have footprints which infringe on the potential habitat of the sheep - the STP (3,421,237,248 sq ft) and the shroud (875,939,328 sq ft). The probability of the STP hitting a sheep is .00000000148, or 1 chance in 675 million. The probability of the shroud hitting a sheep is .00000000569, or 1 chance is 175 million.

LEAP 2 - two pieces of debris have footprints which infringe on the potential habitat of the sheep - the STP (3,421,237,248 sq ft) and the shroud (875,939,328 sq ft). The probability of the STP hitting a sheep is .00000000148, or 1 chance in 675 million. The probability of the shroud hitting a sheep is .00000000569, or 1 chance in 175 million.

LEAP 3 - three pieces of debris have footprints which infringe on the potential habitat of the sheep - the TBAM (1,456,088,832 sq ft), booster (1,745,745,408 sq ft), and PMB. The PMB will have a soft landing (parachute), therefore it was excluded from the analysis. The probability of the TBAM hitting a sheep is .00000000342, or 1 chance in 292 million. The probability of the booster hitting a sheep is .00000000286, or 1 chance in 349 million.

LEAP 4 - one piece of debris has a footprint which infringes on the potential habitat of the sheep - the Orbus (547,252,992 sq ft). The probability of the Orbus hitting a sheep is .0000000091, or 1 chance in 109 million.

Cumulative probability - the cumulative probability of any debris from the LEAP program hitting a sheep is .0000000297, or 1 chance in 33 million.

The potential of debris striking a sheep is minimal. To minimize the disturbance of the bighorn sheep during recovery of debris mitigation measures have been incorporated into the LEAP Test Program and are described in Section 1. The potential impacts of the LEAP test program on the desert bighorn sheep are not significant.

Based on the implementation of the mitigation measures and debris impact radius developed for nominal and maximum impact areas, and the very few pieces of debris anticipated, significant impacts to threatened and endangered species are not expected. The U.S. Fish and Wildlife Service concurs with the analysis that no significant impacts will occur to biological resources resulting from LEAP test activities at the range (see letter Section 4).

3.3.1.7 Cultural Resources

Cultural resources at White Sands are most at risk to an adverse effect as a result of physical destruction, damage, or alteration. The US Army has entered into a Programmatic Memorandum of Agreement (PMOA) with the Advisory Council on Historic Preservation (ACHP) and the New Mexico State Historic Preservation Officer, to which all users of the facility are bound. This document sets forth procedures governing the treatment of archaeological resources on a programmatic basis to which individual actions, such as LEAP, will be subject. Compliance with Section 106 of the National Historic Preservation Act for the LEAP Program falls within the purview of this PMOA.

Pursuant to the PMOA, a Historic Preservation Plan (HPP) has been developed for White Sands. The HPP defines several categories of potential effects upon cultural resources from launch operations at the WSMR. No new construction is planned for the LEAP Program which will utilize existing launch facilities at LC 36 and the Sulf Site. Therefore, no construction related impacts are expected.

Potential impacts associated with LEAP fall within the purview of procedures developed for dealing with missile impacts, and missile recovery operations. Potential missile component impacts from the LEAP Program include the target, PMB, TBAM, spent booster, and shroud. Trajectory analyses for the LEAP Program indicate that debris impacts will be confined to the northwest corner of the 50 mile impact area. Should LEAP trajectories be modified, leading to debris patterns not identified in this EA, a separate impact analysis on cultural resources would be required.

The proposed missile target area has the potential to contain historic and prehistoric cultural resources, and has not been subject to cultural resources investigations. Potential exists for known and unknown cultural resources located on the present ground surface at WSMR to be impacted by missile debris. The HPP specifies that the White Sands Historic Preservation Officer may require archaeological survey of potential missile debris impact areas, followed by avoidance or data recovery.

Potential impacts to cultural resources will be minimized due to the implementation of the mitigation measures outlined in Section 1.2.6 of this report. Therefore, no significant impacts to these resources are expected.

3.3.1.8 Infrastructure

WSMR currently supports high altitude rocket launches, including the use of the Aries booster, from LC 36 and the Sulf Site. Existing support facilities will also be used minimizing the effect on the installation's infrastructure. The number of personnel involved in the launches are typically the number found at similar launches at WSMR. Adequate existing housing and other support services are available at the installation and nearby communities for work crews and technical staff during the pre-flight and flight test activities. Therefore, no significant impacts on infrastructure are expected.

3.3.1.9 Hazardous Materials and Wastes

LEAP flights will use hydrazine or monomethylhydrazine as fuel for the projectile and nitrogen tetroxide as the oxidizer. These liquid propellants are hazardous materials. Each experiment will use a maximum of 504 grams (1.119 lbs) of hydrazine or monomethylhydrazine and a maximum of 833 grams (1.836 lbs) of the oxidizer. The propellants will be transported from the NASA WSTF located approximately 15 miles from WSMR. NASA-WSTF is a treatment, storage, and disposal facility for bipropellant

hazardous materials. Transport to LC 36 covers a total distance of approximately 25 miles (Hughes, 1990).

The potential hazards and consequences to human health and safety resulting from the use of liquid bipropellants are illustrated in Table 7 (page 3-4). The following precautionary measures are implemented to avoid the impacts from the use of these hazardous materials.

All personnel involved in the loading of the propellants will wear OSHA Level B protection, maintaining audio contact. While in the loading room at LC 36, visual, audio, and closed circuit television monitoring will be maintained (Hughes, 1990). Spills will be contained in the loading area through controlled drainage to an underground storage tank.

Removal of hazardous materials and waste, primarily bipropellants, will be by a qualified hazardous waste contractor under the direction of WSMR in accordance with RCRA regulations. Due to the procedures that have been incorporated into the program, no significant impacts due to the use of hazardous materials are anticipated.

3.3.1.10 Safety

Safety issues are involved in each of the phases of the LEAP Program, including component and assembly ground tests, preflight tests, and flight activities. Routine activities will be conducted under directives and formal safety programs already in effect at each facility (SDD, BAE, HAC, et al). These programs also include procedures for addressing circumstances for which there are no readily applicable standards (i.e. OSHA or National Institute of Occupational Safety and Health). To preclude problems and avoid accidents, the extensive work force training and operator certification programs include quality control inspections, spill prevention, control and countermeasure plans, contingency plans, and active operations monitoring.

As identified in Sections 2.2.1.10 and 3.1.10, safety considerations exist for the LEAP Program. Specifically, the development of Standard Safety Operating Plans (SSOP) and

Missile Flight Safety Operational Plans address these concerns. All ground activities will be covered by an SSOP. In addition, the WSMR Ground Safety Officer may require that a separate SSOP be prepared for the use of hydrazine for those flights using the hypergolic fuels. Evacuation precautions, normal procedure at WSMR, will be implemented to minimize danger to installation personnel.

A Missile Flight Safety Plan will also be prepared to cover flight activities due to the safety precautions necessary for handling hazardous substances. Operating limits that will be implemented for the LEAP launches will include not allowing the rocket to violate any WSMR range or evacuation area. Should sensitive areas be threatened, the rocket will be destroyed. All systems must be functional and the destruct system must be certified prior to launch (NRO, 1988).

WSMR has launched over 1,000 high altitude rockets which have included Aries, Black Brant, and Sprint boosters. As a result, the activities that will be occurring during the LEAP launches can be considered routine. Of 32 Aries launches, two, both on WSMR, have had to be destroyed during flight operations due to guidance malfunctions. In both cases, the MFSOP was followed which resulted in all debris landing on range and within the evacuation area. After those aborts, quality control measures were instituted to prevent a reoccurrence of a further guidance malfunction (WSMR, 1990). These incidents indicate the effectiveness of the MFSOP procedures for ensuring flight safety at WSMR.

Transportation of the LEAP liquid propellant will be in accordance with DOT regulations as identified in 49 CFR 178 and 173 including appropriate placarding on the vehicle. Both the hydrazine and the oxidizer will be transported in approved DOT containers. OSHA Level B protection will be worn by all personnel handling the propellants (Hughes, 1990).

As a result of the outlined safety precautions and routine nature of the activities, no significant impacts are expected.

3.3.2 U.S. Army Kwajalein Atoll

The USAKA Environmental Impact Statement is incorporated in this document by reference in accordance with Council on Environmental Quality regulations (40 CFR 1502.21) (USASDC, 1989a). All LEAP Test Program activities are expected to operate within the subsequent Record of Decision and conform to the mitigation measures contained therein (USASDC, 1989c). Aries rockets have previously been launched at USAKA as part of the ERIS program. Therefore, LEAP activities at USAKA will be similar to previous activities.

The following section incorporates a brief review of critical issues identified in the USAKA EIS and addresses potential impacts and required mitigation measures specific to the LEAP Program.

3.3.2.1 Physical Setting and Land Use

Activities associated with LEAP at USAKA will not require new construction or an alteration of land use. The USAKA EIS Record of Decision identifies measures which have been, or are, in the process of being implemented to reduce to non-significant levels the impacts of on-going activities at the facility.

3.3.2.2 Geology and Water Resources

The USAKA EIS identified quarrying activities as the primary activity that could potentially impact island geology. Quarrying at USAKA will continue, as required, regardless of the LEAP Program. Quarrying will be performed in accordance with the USAKA EIS Record of Decision. LEAP activities will not necessitate additional quarrying, and therefore are not expected to result in significant impacts to geology.

Impacts to groundwater supplies will not exceed guidelines and mitigation measures outlined in the USAKA EIS, and therefore will not lead to significant impacts to

groundwater resources. A new desalination plant is planned for completion in FY 92 and will provide an additional 150,000 gallons of potable water per day.

The mitigation plan proposed as part of the USAKA EIS to address potential impacts from solid waste disposal includes improved waste handling procedures and monitoring of water quality in the vicinity of dump sites. All LEAP Program activities must comply with this mitigation plan. LEAP Program activities are expected to occur within the current level of operations at USAKA and as such, have no significant impact to marine water resources.

The appropriate water quality study recommendations, made in accordance with the USAKA EIS must be implemented. This will include increased conservation and improved procedures to handle hazardous waste, thereby reducing the risk of contamination.

3.3.2.3 Air Quality

LEAP activities will conform to the Record of Decision from the USAKA EIS governing mitigation of air quality impacts resulting from military operations at USAKA. An Aries II rocket, will be used for LEAP tests at USAKA. As is the case for the air quality analysis at WSMR, the PUFF transport and dispersion model was used to conduct the analysis for USAKA (Appendix B). Analysis of a routine launch scenario and launch accident scenario for an Aries II booster configuration indicates no significant impacts on air quality associated with LEAP test operations.

Impacts to air quality from HCl have also been assessed. Very little data on the deposition of HC1 and subsequent environmental damage is available from launch vehicles other than the Space Shuttle. This type of information is critical in attempting to assess the potential impacts of HC1 from the LEAP launch vehicle, when actual measurements of HC1 deposition from the LEAP rocket are not available. The analysis presented for the LEAP vehicle attempts to calculate the amount of HC1 that would be deposited in the environment under a bounding case scenario and compare these levels to those documented for environmental damage for the Space Shuttle. This becomes, in effect, a comparison of

amounts of HC1 deposition, not a comparison of the amounts of HC1 produced by each vehicle.

The environment of Meck Island is more similar to that of CCAFS, in that it is a marine-influenced climate, with relatively high humidity. However, due to the small size of the island and constant sea breezes, any HCl deposition would be rapidly neutralized by the presence of sea salts on the vegetation and soils. There are no freshwater surface water sources in the vicinity of the Meck Island launch site.

Based on comparisons of the quantities of HCl generated by the LEAP vehicle as compared to the Space Shuttle, the state of HCl deposition (dry versus wet), the climatology and general environmental factors of the LEAP launch sites, significant HCl impacts to surrounding vegetation or surface waters are not anticipated. For the noted reasons, no significant impacts to air quality are expected.

3.3.2.4 Noise

No significant impacts from noise contributions resulting from rocket launches were identified in the USAKA EIS. The LEAP Program is projected to follow the mission profiles of launch activities already assessed at USAKA, and to conform to the EIS Record of Decision. Therefore no adverse noise impacts are anticipated from LEAP Program activities.

3.3.2.5 Biological Resources

Potential impacts to terrestrial biological resources at USAKA are associated with disturbance of seabird habitat, increased harvesting of the coconut crab and long-term damage to island flora from missile launch activities. Potential impacts to marine biological resources at USAKA are associated with dredging maintenance of the harbor areas, wastewater treatment discharges, and quarrying.

The LEAP Test Program will use existing launch facilities and will not require new construction. Furthermore, the LEAP Program will adhere to mitigative measures included in the USAKA EIS and the subsequent Record of Decision. Therefore, no significant impacts to biological resources are expected.

3.3.2.6 Rare, Threatened and Endangered Species

Rare, threatened, or endangered species as listed in the USAKA EIS (USASDC, 1989) include the giant clam (Tridacna gigas), the threatened green turtle (Chelonia mydas), the endangered hawksbill turtle (Eretmochelys imbricata) and a rare seagrass (Halophilla minor). The potential loss of these species, as well as their habitat, is an area of concern.

The LEAP Program will adhere to mitigation measures outlined in the USAKA EIS and subsequent Record of Decision designed to protect these species and their habitat, including: prohibiting the taking of giant clams, and relocation of giant clams in the vicinity of military operations, among others. Therefore, no significant impacts to threatened and endangered species are expected.

3.3.2.7 Cultural Resources

As previously stated, the LEAP Test Program will not require new construction at USAKA and will be similar to activities addressed in the USAKA EIS and subsequent Record of Decision. The program will conform with all mitigation measures pertaining to cultural resources. Therefore, no significant impacts to cultural resources are expected.

3.3.2.8 Infrastructure

Infrastructure impacts at USAKA would include changes in demand on the potable water system, wastewater collection and treatment, solid waste removal and disposal, transportation, and medical and educational facilities. Of these resources, the demand for potable water and housing to support base activities is most at issue.

Housing conditions are cited in the USAKA EIS as an inhibiting factor in the recruitment and retention of personnel. LEAP activities at USAKA are expected to require approximately 25 persons for approximately 6 weeks. The number of personnel for LEAP is less than the number of personnel required for other SDI programs at USAKA such as the ERIS Program. Timing of their arrival will be in accordance with requirements of the USAKA Record of Decision. Therefore, significant impacts on housing conditions at the base are not expected.

In that a major relocation of personnel to USAKA is not anticipated as a result of LEAP activities, a significant impact on transportation, medical, solid waste collection and educational facilities is not anticipated. A major relocation of personnel to USAKA will be precluded by measures to mitigate possible impacts to wastewater treatment, educational, and housing facilities which are operating near or at capacity. Specific measures, in accordance with the USAKA EIS mitigation plan include:

- The retention of trailers for housing. However, the availability of existing housing should be addressed prior to initiation of LEAP activities at USAKA.

3.3.2.9 Hazardous Materials and Wastes

Appropriate measures for the handling of hazardous materials are operational at USAKA. Current programs relative to the storage and disposal of hazardous wastes are being structured in accordance with the USAKA ROD. LEAP activities at USAKA will conform to the ROD and subsequent mitigation measures. Therefore, no significant impacts are expected.

3.3.2.10 Safety

Hazards to human health at USAKA relate mainly to the handling of hazardous and explosive substances, and missile launch activities. Elements of proposed LEAP activities

at USAKA will involve an increased use of hazardous substances. LEAP activities will be consistent with previous missions at USAKA (SDIO, 1987), and will be conducted within existing regulations, which provide safety to personnel, and the USAKA EIS Record of Decision. Therefore, no significant impacts to human safety at USAKA are anticipated.

3.3.3 WAKE ISLAND

3.3.3.1 Physical Setting and Land Use

Modifications to the existing facilities associated with LEAP activities include the refurbishing of existing base facilities and minor modifications to an existing launch pad and missile assembly building. Potential land use issues include loss or reduced quality of use and restrictions on present or future uses. However, renovation of existing buildings represents an insignificant impact to land use.

The LEAP facilities will be off limits to base personnel during modifications and subsequent inactive periods between launches. Removal of this small area from use will not constitute a significant restriction to base operations or recreational opportunities. During active launch periods (i.e., when the missiles are readied on the launch rails with FTS systems installed) and during the actual launches, all of Peacock Point will be off limits to all non-authorized personnel. Restricted zones will include beach and ocean areas. These areas could be off limits for several weeks. Restrictions will not result in significant impacts to land use because they are short term, and ample beach areas for recreation are available elsewhere on Wake Island. There is presently no public access to the areas to be restricted (the entire island is a military reservation); therefore, the public will not be affected by the proposed action.

3.3.3.2 Geology and Water Resources

Potential impacts to geology and water resources include soil contamination and soil erosion. The modification/construction associated with LEAP are not expected to have any

significant impacts on runoff/percolation. The Starbird facilities present on Wake island are located away from sensitive and/or erodible features (USASDC, 1987). No vegetation will be cleared for such modifications.

3.3.3.3 Air Quality

Wake Island has a marine tropical climate similar to USAKA on Kwajalein. Both Wake Island and Kwajalein are characterized by a climate with little variation in temperature and humidity, but high variations in rainfall (USASDC, 1989; NOAA, 1990). Prevailing winds on Wake Island are predominantly from the northeast and east-northeast, with an average velocity of 13 mph (NOAA, 1990). Winds on Kwajalein are also predominantly from the northeast, with an average velocity of 12.5 mph (USASDC, 1989). Therefore, pollutant dispersion characteristics would be similar overall between Wake Island and Kwajalein. The amount of emissions produced by the Castor IVA first stage used on the LEAP target rocket is comparable to rocket motors analyzed for similar climatic conditions at USAKA and found to be nonsignificant. The relatively constant northeastern sea breeze should rapidly disperse any ground-level emissions away from the inhabited portions and small land area of Wake Island. Although wind conditions aloft can change the calculation of emission concentrations from rocket launches, LEAP flight tests are not expected to result in concentrations of emissions that are substantially different from those calculated at USAKA (USASDC, 1989). Therefore, air quality impacts from solid boosters are not considered to be significant.

Portable generators used during the LEAP experiments will be small, temporary, stationary sources, and will not require specific permits for their operation. Their impact on overall air quality will be minimal.

3.3.3.4 Noise

The proposed launches of the LEAP vehicle will produce brief but intense sound events (USAF, 1990). Typical noise and sonic booms will occur with each launch; however,

routine measures will be used to protect personnel from the noise at the launch pad. Also, during the time the LEAP vehicle exceeds the speed of sound, a sonic boom will be directed toward the front of the vehicle down range of Wake Island over the ocean (USAF, 1990).

Noise levels during the launch of an Athena-H booster at Wake Island in 1972 were monitored by Air Force personnel (Capell, 1972). The Athena-H first stage was a Castor IV, which compares to the Castor IVA as shown in Table 9 below (Thiokol, 1989).

As the above data indicate, the Castor IVA is about 1,800 pounds heavier and has 15 percent more thrust than its predecessor. Sound levels at launch of the Castor IVA are expected to be comparable to the Castor IV.

TABLE 9

CASTOR IV NOISE LEVELS

	Castor IV	Castor IVA
Propellant Weight (lbm)	20,545	22,350
Propellant Type	PBAA Polymer, 14% AL	HTPB Polymer, 20% AL
Thrust (lbf)	84,860	97,520
Burn Time (sec)	54.3	53.1

During the launch, sound levels were measured at two distances from the launch site--600 feet and 2,500 feet. The height of the rocket at 3.2 seconds after launching, the time at which the maximum noise level was measured, was 700 feet. Maximum sound levels recorded were 122 dBA at 600 feet and 109 dBA at 2,500 feet.

Based on the above data, projected noise levels from a LEAP launch would be as shown in Table 10 below:

TABLE 10
NOISE LEVELS - WAKE ISLAND

Location	Distance From Pad No. 3 (feet)	Projected Launch Noise Level (dBA)
Launch Support Building	3,300	107-111
Base Headquarters/ WWII Memorial	4,500	104-108
Closest Base Housing	8,[illegible]00	99-103
Dining Hall/ Barracks	14,000	94-98
Wilkes Island (midpoint)	19,000	92-96

The above projections are presented as a range; because of experimental variation, the measurements at 2,500 feet resulted in lower projected levels than measurements at 600 feet.

Personnel in the LSB would remain indoors during the launch. Non-authorized personnel would be excluded from the launch area and thus be protected from noise effects. Other personnel who were outside working or observing the launch (i.e., on the roof of base headquarters) would be exposed to noise levels less than OSHA's maximum exposure level of 115 dBA for 15 minutes or less. Protection for closed-in personnel, as well as noise attenuation over distance, will prevent significant impacts to humans from the LEAP launches.

Noise levels exceeding 95 dBA could possibly cause a temporary hearing loss in sensitive wildlife living near the launch pad.

Hearing loss has been documented for desert animals exposed to 95 dBA for durations less than 9 minutes (Brattstrom and Bondello, 1983). The 95 dBA radius of impact for LEAP launches is estimated to be approximately 19,000 feet and intersects the middle of Wilkes

Island. However, because of the short duration of intense sound, and the low number of launches, significant impacts from noise on wildlife are not expected.

Portable electric generators will be used for some of the remotely located launch facilities for which base power is not available. Personnel working in the immediate areas of operating generators will wear hearing protection in accordance with OSHA regulations. Therefore, significant impacts are not expected.

3.3.3.5 Biological Resources

The modifications to existing facilities will not affect the vegetation present on Wake Island. Such facilities are located in previously cleared and disturbed areas.

The nesting bird colonies on Wilkes and Peale Islands, many of which are protected by the Migratory Bird Treaty Act, will not be affected by LEAP modifications of existing facilities. Few birds of solitary nesting species are found on Wake Island, and no evidence of recent nesting was observed at the Starbird sites during recent surveys (USASDC, 1987; USAF, 1990). Protective and preventative measures, as described in the 1987 EA for the Starbird project (USASDC, 1987), will be adopted for the LEAP programs. Commitments have been made to minimize the disturbance of seabirds and limit human intrusion.

Various wildlife habitats, particularly those of nesting seabirds, may be sensitive to the increased development of Wake Island. The following proposed mitigation measure will prevent potential significant impacts from the temporary radar/telemetry sites for LEAP launches:

- Planning of alternative, feasible sites that are environmentally acceptable. The specific site will be agreed upon in response to wildlife activity in the area, immediately prior to placement of the portable radar/telemetry equipment.

3.3.3.6 Threatened and Endangered Species

No impacts on threatened or endangered species are expected to occur. Of the federally listed and other protected species of marine mammals discussed in Section 2.2.3.6, only the green turtle is known to be present in the area, and it would not be affected by either modification or operation activities. The 15th ABW at Hickam, AFB, Hawaii, has agreed to take the lead responsibility in educating all personnel on or visiting the atoll not to harm or harass any sea turtles in the near-shore waters (USAF, 1990). This program will be continued during LEAP operations. The LEAP launch azimuth to the southeast (as compared to the east-northeast launch for Starbird) is not expected to affect protected species.

The consultation process with USFWS (specified by Section 7 of the Endangered Species Act) has been concluded, and they have concurred that LEAP activities will not significantly impact the federally protected species at Wake Island (Kosaka/ USFWS, 1990). The USFWS also determined that consultation with the National Marine Fisheries Service would not be required due to the lack of impacts to the endangered sea turtles.

3.3.3.7 Cultural Resources

Potential impacts on historic resources during project construction activities could occur because Wake Island is a designated National Historic Landmark. Preventative and mitigation measures described in the 1987 Starbird EA (USASDC, 1987) are adopted by this EA and will be included in subsequent modification and operations specification packages. No project activities will occur within 75 feet of any structures shown on the National Register Nomination Map (USASDC, 1987). No clearing, grading, excavation, or other activities will be conducted that would endanger the structural integrity or modify the appearance of these landmark structures.

During LEAP site preparation activities, mitigation outlined in Section 1.2.1 (see Historical Resources) will also be adhered to. Consultation with the ACHP under Section 106 of the

National Historic Preservation Act has been initiated. No significant impacts on cultural resources are currently expected.

3.3.3.8 Infrastructure

The LEAP second stage will not require supplemental power or other services beyond those available at the launch pad. Radar/telemetry sites will use portable generators. A temporary microwave system will be used for communications between the various activities on Wake Island. LEAP activities are not expected to impact power generation or availability on Wake Island.

Adequate existing housing and support services are available for work crews and technical staff during both modification and flight test activities. Modification activities will require a work force of 10 - 40 personnel for a 2 - 4 month period. Approximately 100 - 125 personnel will be specifically assigned to LEAP activities and will be on location during launches. No significant impacts are expected.

3.3.3.9 Hazardous Materials and Wastes

Waste disposal sites and potential environmental contamination sites were disclosed during a 1984 Phase I records search (Engineering-Science, 1984). However, no waste sites at the proposed LEAP sites were found, and recommendations provided in the Phase I report do not preclude the types of activities proposed for LEAP. Modification activities and use of LEAP facilities, with consideration of the nearby waste sites, should have minimal impact from existing waste disposal sites.

3.3.3.10 Safety

Safety issues are involved in each of the basic segments of the LEAP preflight and flight test programs. Routine activities will be conducted under directives and formal safety programs already in effect at Wake Island. These programs also include procedures for

addressing circumstances for which there are no readily applicable standards (i.e. OSHA or National Institute of Occupational Safety and Health). To preclude problems and avoid accidents, the extensive work force training and operator certification programs include quality control inspections, spill prevention, control and countermeasure plans, contingency plans, and active operations monitoring.

3.4 CUMULATIVE IMPACTS

3.4.1 Ground Activities

All ground activities associated with the LEAP Program are routine to the operations within which they take place. No additional employees are hired to perform LEAP related work at these locations. All contractor facilities participating in the LEAP Test Program are required to comply with federal, state, and local regulations which guarantee the maintenance and integrity of environmental resources. These regulations include but are not limited to the:

* Clean Air Act;
* National Environmental Policy Control Act of 1969;
* Clean Water Act of 1977;
* Resource Conservation and Recovery Act of 1976;
* Toxic Substances Control Act;
* Comprehensive Environmental Response, Compensation and Liability Act of 1980.

Compliance with these regulations ensures that LEAP activities will not contribute to cumulative environmental impacts at the various contractor facilities and other ground activity locations.

3.4.2 Launch Impacts

As previously stated, WSMR has conducted over 37,000 missile launches, including over 1,000 high altitude launches since its inception. WSMR currently averages, on an annual basis, approximately 450 rocket and missile launches varying in size from hand-held stinger missiles to high-altitude research rockets such as the Aries. High-altitude rocket launches have ranged from a high of 34 in 1987 to a low of 11 in 1984 with 12 launches having

occurred in both 1988 and 1989. During 1990, 14 high altitude research rockets were launched, creating an average for the last three years of 13 launches. Projections for 1991 and 1992 indicate 15 - 18 high altitude research rockets will be launched in each of those years. These totals reflect the projected LEAP test flights which will take place at the range (WSMR NR-PD, 1990). These projected total launches are very near the annual average, and well below the 1987 level of activity.

Debris dispersion areas for the LEAP Test Program (Figures 7A - 7D) are separate and distinct from dispersion areas for other program test launches at WSMR. For example, the debris dispersion area for the ERINT Program extends in a northwesterly direction from the LC-50 launch site. The debris dispersion area for HEDI program launches at WSMR extends in a northwesterly direction from the LC-37 launch site.

Therefore, no cumulative impacts are anticipated from the addition of LEAP test launches at WSMR. Any additional flights that might be added at a later date would, however, need to stay within the normal range of activities at WSMR.

The environmental analyses demonstrate it is very unlikely that impacts will occur to any environmental media. The environment immediately adjacent to launch pads have been exposed to a number of launches. Therefore, any changes to species composition as a result of launch activities would have already occurred. In the case of air emissions, occurrences are sporadic, single event episodes with rapid dispersion. For the emission of HCl, there will be no cumulative effects because HCl biodegrades rapidly in the environment.

A description of the reliability of boosters and rocket motors used in the LEAP Test Program is provided in Section 1.2.4.5. The reliability of the various boosters used in the program is very high. This factor contributes to the conclusion that launch activities will not contribute to cumulative impacts at WSMR or USAKA.

The USAKA EIS (USASDC, 1989a) identifies the physical constraints associated with SDI related launches from that location. The mitigation plan developed in support of the

Record of Decision identified specific mitigation measures to address potential impacts occurring from SDI-related activities at USAKA. These include the installation of trailers for supplemental housing, waste discharge and water quality monitoring programs, and improved solid waste handling, storage, and minimization. Based on the parameters established for the two LEAP flights from USAKA, and the parameters outlined in the USAKA ROD and mitigation plan, no significant impacts to environmental media are expected. If the parameters of the planned activities change from those currently established, additional environmental analysis and documentation would be required.

4.0 LIST OF AGENCIES AND PERSONS CONSULTED

4.0 AGENCIES AND PERSONS CONSULTED

Robert Andreoli
White Sands Missile Range Environmental Coordinator
White Sands Missile Range, New Mexico

Daniel W. Bowholtz, Captain, USAF
Acting Chief, Environmental Planning and Compliance
Edwards Air Force Base, California

Naval Ordnance Missile Test Station
White Sands Missile Range, New Mexico

New Mexico Department of Forestry and Resource Conservation

New Mexico Department of Game and Fish

New Mexico State Historic Preservation Office

U.S. Army Kwajalein Atoll Facility Environmental Coordinator
United States Army Kwajalein Atoll

U.S. Fish and Wildlife Service
Albuquerque, New Mexico

U.S. Fish and Wildlife Service
Pacific Island Office
Honolulu, Hawaii

National Marine Fisheries Service
Pacific Area Office

DEPARTMENT OF DEFENSE
STRATEGIC DEFENSE INITIATIVE ORGANIZATION
WASHINGTON, DC 20301-7100

TNE

JUN 11 1991

Jennifer Fowler-Propst
Field Supervisor
U.S. Fish and Wildlife Service
Suite D, 3530 Pan American Highway, NE
Albuquerque, New Mexico 87107

Dear Ms. Fowler-Propst:

Enclosed please find a copy of the **Analysis of Potential Impacts to Species of Concern.** The report summarizes our findings of potential impacts to state and Federally protected species resulting from Lightweight ExoAtmospheric Projectile (LEAP) activities at White Sands Missile Range as identified in your letter of March 1, 1991. Additionally, the report includes responses to those issues raised during our meeting on May 24, 1991.

Specifically, an analyses of probable impacts to habitat for the Todsen's pennyroyal and Aplomado Falcon are presented in the report. Probability analyses for impacts to Salt Creek, habitat for the White Sands pupfish, and the desert bighorn sheep are also included.

Our conclusion from this analysis is that LEAP activities at White Sands will not result in potentially significant impacts to species of concern. If you have any comments or questions regarding this analysis, please contact Captain Gale Brown at (703) 693-1585. We would appreciate your expediting your review and response on this matter.

Sincerely,

Michael T. Toole

MICHAEL T. TOOLE
Colonel, USAF
Director, Test & Evaluation

Enclosure:
as stated

cc: Ms. Nita Fuller
U.S. Fish and Wildlife Service
Albuquerque, New Mexico 87103-1306

Bob Jenks
New Mexico Department of Game and Fish
Villagra Building - State Capitol
Santa Fe, New Mexico 87503

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Ecological Services
Suite D, 3530 Pan American Highway, NE
Albuquerque, New Mexico 87107

June 25, 1991

Cons. No. 2-22-91-I-097

Col. Michael T. Toole
U.S. Air Force
Director, Test and Evaluation
Department of Defense
Strategic Defense Initiative Organization
Washington, D.C. 20301-7100

Dear Colonel Toole:

This responds to your letter dated June 11 1991, requesting comments on the report, "Analysis of Potential Impacts to Species of Concern", by Louis Berger and Associates, June 1991. The report is a response to the U.S. Fish and Wildlife Service (Service) comments of March 1, 1991, on the Draft Environmental Assessment for the Lightweight Exoatmospheric Projectile (LEAP), dated November 3, 1990.

Our specific concerns about LEAP are the effects of falling debris and potential fire hazards on rare plant and animal species on White Sands Missile Range (WSMR) and adjacent areas. The Todsen's pennyroyal (Hedeoma todsenii), aplomado falcon (Falco femoralis septentrionalis), White Sands pupfish (Cyprinodon tularosa) and desert bighorn sheep (Ovis canadensis mexicana) are known to occur or have potential for occurring in the WSMR area. The aplomado falcon has not been observed on WSMR; therefore it was not considered further in the analysis. The probability of falling debris striking the known locations and potential habitats of the White Sands pupfish, Todsen's pennyroyal, and desert bighorn sheep, has been calculated.

In the event of debris falling within potential habitat for Todsen's pennyroyal, the following mitigation measures have been proposed by the Strategic Defense Initiative Organization (SDIO):

1. If debris lands within 400 meters of the potential habitat area, recovery personnel will immediately notify the Chief, Range Support Section. No recovery operation will be undertaken in the potential habitat area without the concurrence of the Chief, Range Support Section, Research Rockets Director NOMTS, and the Chief, Environmental and Natural Resources Division.

2. No vehicles will enter within 400 meters of potential habitat unless the personnel in charge have personally coordinated the matter with the Environmental Chief or his authorized representative.

3. All recovery operations within 400 meters of the potential habitat area will be coordinated with the Chief, Environmental and Natural Resources Division.

4. No excavation of missile debris in the potential habitat area or outside the designated impact area will be conducted without contacting the Chief, Environmental and Natural Resources Division and the Chief, Range Support Section. All disturbed areas will be restored to match the surrounding terrain.

5. Helicopters will be used to recovery debris when necessary to prevent environmental damage, and when recovery is necessary in areas not accessible by vehicle.

6. An airplane will be on standby to deliver slurry to the potential pennyroyal habitat in the event of fire. All fire protection activities in the potential habitat will be coordinated with the Chief, Environmental and Natural Resources Division.

The Service recommends the fourth mitigation measure include a stipulation that all disturbed areas be reseeded with native plant species, if necessary, following restoration of ground contours to match the surrounding terrain.

The following mitigation measures have been proposed by the SDIO for the White Sands pupfish.

1. No recovery operation will be undertaken in the Salt Creek area without the concurrence of the Chief, Environmental and Natural Resources Division, and the Chief, Range Support Section, Research Rockets Director NOMTS.

2. No vehicles will enter within 400 meters of Salt Creek unless the personnel in charge have personally coordinated the matter with the Environmental Chief or his authorized representative.

3. All recovery operations within 400 meters of Salt Creek will be coordinated with the Chief, Environmental and Natural Resources Division.

4. No excavation of missile debris will be undertaken without notification of the Chief, Range Support Section, and Chief, Environmental and Natural Resources Division. No excavation will be conducted without an environmental representative present at the site. After the debris removal, all disturbed areas will be restored to match the surrounding terrain.

5. Helicopter recovery of debris will be utilized, when necessary, to prevent damage to the environment and when debris has fallen in areas not accessible by vehicle.

The Service recommends the fourth mitigation measure include a stipulation that all disturbed areas be reseeded with native plant species, if necessary, following restoration of ground contours to match the surrounding terrain.

The following mitigation measures have been proposed by the SDIO for the desert bighorn sheep.

1. All recovery operations will be coordinated with the Chief, Environmental and Natural Resources Division, on recovery of missile debris in the San Andres Mountains.

2. Helicopters will be used, when necessary, to prevent damage to the environment or when recovery is necessary in areas not accessible by vehicle.

3. No debris recovery will be undertaken near Strawberry Peak, by helicopter or vehicle, when bighorn sheep are in the area.

The Service recommends that the following measure be added to mitigate impacts to the bighorn sheep:

4. All recovery operations within habitat for bighorn sheep will be coordinated with the Refuge Manager, U.S. Fish and Wildlife Service, San Andres National Wildlife Refuge.

If the above mitigation measures are implemented, we believe the LEAP project will have no significant adverse effect on the Todsen's pennyroyal, White Sands pupfish, or desert bighorn sheep. However, LEAP is only one of many programs at WSMR that could potentially harm rare and sensitive species because of noise and visual disturbance, falling debris, fire, and toxic chemicals. Future analyses should include the cumulative effects of similar projects conducted at the same time on White Sands Missile Range.

If you have any questions, please contact Gerry Roehm or Anne Cully, (505) 883-7877.

Sincerely,

Michael J. Donahoo

for Jennifer Fowler-Propst
Field Supervisor

cc:
Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico
Director, New Mexico Energy, Minerals and Natural Resources Department, Forestry and Research Conservation Division, Santa Fe, New Mexico
Regional Director, U.S. Fish and Wildlife Service, Fish and Wildlife Enhancement & Refuges and Wildlife, Albuquerque, New Mexico
Refuge Manager, U.S. Fish and Wildlife Service, San Andres National Wildlife Refuge, Las Cruces, New Mexico

5.1.4

DEPARTMENT OF DEFENSE
STRATEGIC DEFENSE INITIATIVE ORGANIZATION
WASHINGTON, DC 20301-7100

MAR 11 1991

ENE

Mr. William Kramer, Deputy Field Office Supervisor
Office of Environmental Services
Fish and Wildlife Service - Pacific Islands Office
U.S. Department of the Interior
P.O. Box 50167
Honolulu, HI 96850

Dear Mr. Kramer

In April 1989, Mr. Dru Barrineau of the U.S. Army Strategic Defense Command visited your office to discuss the HEDI Project activities to be accomplished on Meck Island, Kwajalein, Marshall Islands. The result of that visit was concurrence that the proposed activities would have no effect on plant and animal species nor any threatened and endangered species.

The Strategic Defense Initiative Organization (SDIO) is proposing to execute a similar project, the Lightweight ExoAtmospheric Projectile (LEAP) program, also on Meck Island. The purpose of the LEAP program is to design, develop and demonstrate the capability of a miniaturized, lightweight projectile to intercept targets in the exoatmospheric region. The LEAP program would use existing facilities and the same type of rocket boosters (Aries) used in previous launches.

Attached is a copy of the relevant sections of the preliminary final environmental assessment (EA) prepared for the LEAP program activities at the U.S. Army Kwajalein Atoll (USAKA). The EA is a programmatic EA which assesses all the proposed LEAP program activities including those proposed for Meck Island. The analysis approach used for the activities proposed at Meck Island is to summarize the salient points from the USAKA Final Environmental Impact Statement and incorporate by reference the detailed analysis. Our conclusions indicate that there will be no significant affects from implementing the proposed LEAP activities at Meck Island. Request you review this information and provide your coordination to this office not later than March 22, 1991.

Mr. Larry Walker of Louis Berger International, a member of the SDIO Environmental Technical Support contract team will be visiting your office to discuss this material with you and to answer any questions you may have regarding this proposal. We apologize for the short suspense regarding this request. Should you have any questions, please call Captain Gale Brown or me at (202) 693-1833.

Sincerely,

RICHARD A. RITTER
Lt Col, USAF
Director, Engineering Support

Attachments:
As stated

cc:
SDIO/ENE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS OFFICE
P.O. BOX 50167
HONOLULU, HAWAII 96850

RECEIVED 28 Mar 91

March 21, 1991

Lieutenant Colonel Richard A. Ritter
Director, Engineering Support
Strategic Defense Initiative Organization
Washington, D.C. 20301-7100

Dear Colonel Ritter:

This responds to your March 11, 1991 request for our review of the Lightweight ExoAtmospheric Projectile (LEAP) program proposed for Meck Island, Kwajalein, Republic of the Marshall Islands. Specifically, you requested our concurrence that the program will have no significant impact on those fish, wildlife, plant, and habitat resources within this Service's jurisdiction, including those plants and animals protected by the Endangered Species Act of 1973 (i.e., listed or proposed endangered or threatened species). The project would require various ground operations involving assembly and preflight checkout tests, flight tests involving launches and the gathering of data, and the recovery of launch vehicle debris and instrumentation. Details of the proposal and its possible impacts were presented in the LEAP Program Environmental Assessment (Assessment) provided to me by Mr. Larry Walker of Louis Berger & Associates, Inc. earlier today.

We agree with Section 2.2.2.6 of the Assessment (Threatened and Endangered Species) which documents that there are no threatened or endangered terrestrial plant or animal species on Meck Island. Further, the LEAP program will use existing launch facilities and will not require new construction. Launches will be limited in number, as described in the Assessment. In consideration of this information , we concur with the determination stated in part 3.3.2.5 (Biological Resources) that the LEAP project will have no significant impact on any resources within this Service's jurisdiction.

Threatened green sea turtles and endangered hawksbill sea turtles may occur in the waters surrounding Meck. Those species, however, fall under the jurisdiction of the National Marine Fisheries Service (NMFS) when they are in the water; as such, NMFS should also be allowed to review the project.

Thank you for the opportunity to review the LEAP documentation. If we can be of further assistance, please contact us again.

Sincerely,

William R. Kramer

William R. Kramer
Section 7 Consultant
Pacific Islands Office

cc: L. Walker, Louis Berger & Associates, 1819 H St, NW, Washington, D.C. 20006
C. Nitta, National Marine Fisheries Service, Honolulu, HI

DEPARTMENT OF DEFENSE
STRATEGIC DEFENSE INITIATIVE ORGANIZATION
WASHINGTON, DC 20301-7100

TNE

APR 3 1991

Mr. John Naughton
National Marine Fisheries Service
Pacific Area Office
2570 Dole Street
Honolulu, HI 96822

Dear Mr. Naughton

This letter is a followup to your teleconference with John Kittridge of Dames & Moore Special Services and Larry Walker of Louis Berger International, SDIO's Technical Support Contractor. As discussed, SDIO is proposing to execute a program, the Lightweight ExoAtmospheric Projectile (LEAP) program, on Meck Island, United States Army Kwajalein Atoll (USAKA). The purpose of the LEAP program is to design, develop and demonstrate the capability of a miniaturized, lightweight projectile to intercept targets in the exoatmospheric region. The LEAP program would use existing facilities and the same type of rocket boosters (Aries) used in previous launches.

Attached is a copy of the relevant sections of the preliminary final environmental assessment (EA) prepared for the LEAP program activities at USAKA. The EA is a programmatic EA which assesses all the proposed LEAP program activities including those proposed for Meck Island. The analysis approach used for the activities proposed at Meck Island is to summarize salient points from the USAKA Final Environmental Impact Statement and incorporate by reference the detailed analysis. Our conclusions indicate that there will be no significant affects from implementing the proposed LEAP activities at Meck Island. Request you review this information and provide your coordination regarding this proposal.

In addition to the relevant sections of the LEAP EA, we have also enclosed a copy of the concurrence letter that Mr. William Kramer, Pacific Islands Office, U.S. Fish and Wildlife Services, regarding the proposed LEAP activities. We apologize for the short suspense regarding this request. We do appreciate your cooperation. Should you have any questions, please call me at (202) 693-1833.

Sincerely,

Virginia G. Brown

VIRGINIA G. BROWN
Captain, USAF
SDIO, Environmental Coordinator

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Area Office Southwest Region
2570 Dole Street Honolulu, HI 96822
PH: (808)955-8831 FAX: (808)949-7400

April 8, 1991 F/SWR13:JJN

RECEIVED 15 Apr 91

Virginia G. Brown
Captain, USAF
SDIO, Environmental Coordinator
Department of Defense
Strategic Defense Initiative Organization
Washington, D.C. 20301-7100

Dear Capt. Brown:

This is in response to your letter of April 3, 1991 requesting the National Marine Fisheries Service (NMFS) review of the Lightweight ExoAtmospheric Projectile (LEAP) program on Meck Island, United Stated Army Kwajalein Atoll (USAKA). As you know, I discussed the proposed LEAP program and its potential environmental effects with Mr. Larry Walker and Mr. John Kitteridge, both working with environmental support contractor companies to the Strategic Defense Initiative Organization (SDIO). In addition, NMFS has reviewed the environmental assessment for the LEAP program activities at USAKA and we offer the following comments for your consideration.

NMFS reviewed and commented on the draft Environmental Impact Statement (DEIS), Proposed Actions at USAKA, Republic of the Marshall Islands (letter from Regional Director E.C. Fullerton dated August 4, 1989 is enclosed for your information.) It is our understanding that the LEAP Program at USAKA will basically consist of two additional launches from Meck Island against targets launched from Wake Island. The LEAP program would use existing facilities and the same type of Aries rocket boosters used in previous launches. No new construction will be required for the LEAP test program. In addition, the LEAP test program will adhere to all mitigation measures included in the USAKA EIS and the subsequent Record of Decision. This specifies the protecting of habitat for marine resources, including the listed threatened and endangered species found at Kwajalein Atoll. Furthermore, we understand the taking of giant clams (Tridacna gigas) will continue to be prohibited at the site which, as can be seen from the enclosed letter, was a concern to NMFS during our review of the EIS for activities at USAKA.

In view of the above, NMFS believes that activities associated with the proposed LEAP test program will have no significant impact on those living marine resources and their habitats which fall under our jurisdiction. We appreciate the opportunity to comment. Should you require further assistance please contact me at the above address.

Sincerely yours,

John J. Naughton

John J. Naughton
Pacific Islands
Environmental Coordinator

Enclosure

cc: F/SWR, Terminal Is., CA
FWS, Honolulu
EPA, Region 9 (E-4)
Corps of Engineers, Honolulu District

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
300 S. Ferry Street
Terminal Island, CA 90731

August 4, 1989 F/SWR13:JJN

U.S. Army Strategic Defense Command
Attention: CSSD-H-SSP (LTC Ronald A. Keglovits)
P.O. Box 1500
Huntsville, Alabama 35807-3801

Dear Sir:

NOAA Fisheries, Southwest Region has reviewed The Draft Environmental Impact Statement (DEIS), Proposed Actions at U.S. Army Kwajalein Atoll (USAKA), Republic of the Marshall Islands.

In order to provide as timely a response to your request for comments as possible, we are submitting the enclosed comments to you directly, in parallel with their transmittal to the Department of Commerce for incorporation in the Departmental response. These comments represent the views of the Southwest Region. The formal, consolidated views of the Department should reach you shortly.

Sincerely yours,

EC Fullerton
E.C. Fullerton
Regional Director

cc: F/SWR13, Naughton

NOAA Fisheries, Southwest Region DEIS Comments

The Draft Environmental Impact Statement (DEIS), Proposed Actions at U.S. Army Kwajalein Atoll (USAKA) has been received by NOAA Fisheries, Southwest Region for review and comment. The DEIS has been reviewed and the following comments are offered for your consideration.

General Comments

NOAA Fisheries was consulted during the planning stages of the proposed project and during development of the DEIS. This included participation in the project scoping meeting, consultation under Section 7 of the Endangered Species Act, discussions with individuals preparing various portions of the DEIS, and site inspections of specific areas of Kwajalein Atoll. Resources for which NOAA Fisheries' bears a responsibility and alternatives to reduce adverse impacts on these resources have been for the most part addressed to our satisfaction in the document.

The Proposed Action alternative is to provide test range facilities and support services at USAKA for continuing research, development, operational space track missions, and Strategic Defense Initiative (SDI) activities. The primary concern of NOAA Fisheries is the anticipated necessity to increase dredging and quarrying adjacent to specific islands in Kwajalein Atoll to accommodate the required USAKA facilities. We believe these activities should be minimized and, when conducted, all mitigation measures proposed in the DEIS should be made mandatory. Our observations support the statement in the DEIS that quarries dredged on the ocean reef flat, if properly located, shaped, and of appropriate depth, create habitat supporting a greater diversity and abundance of marine biota than found in the surrounding sparsely populated ocean reef flat. We strongly recommend that all additional quarries at USAKA be designed to meet the specifications detailed in the DEIS to maximize new habitat.

NOAA Fisheries is also concerned about the increase in recreational diving at USAKA under the Proposed Action, and the impact this may have on the giant clam (Tridacna gigas). Collecting pressure from recreational divers could wipe out the remaining giant clam population at Kwajalein Atoll. Consequently, we concur with the mitigation measures proposed in the DEIS and particularly recommend the proposed prohibition on taking giant clams at USAKA.

Specific Comments

3.6 MARINE BIOLOGICAL RESOURCES

Reef Fishes

Page 3-73, paragraph 2. The statement is made in this section that "The reef fishes of Kwajalein Atoll include 239 species and 46 families of bony fish and 9 species and 5 families of sharks and rays". In a recent checklist of fishes of the Marshall Islands the authors recorded a total of 817 species in 338 genera and 92 families (Randall, J.E. and Randall, H.A., 1987. Fishes of Eniwetok and other Marshall Islands, in: The Natural History of Eniwetok Atoll, U.S. Dept. of Energy). Consequently it is quite probable that there are considerably more than 239 species of reef fishes inhabiting Kwajalein Atoll.

5.1.4

RESOURCE MANAGEMENT AGENCY

RANDALL L. ABBOTT
DIRECTOR

DAVID PRICE III
ASSISTANT DIRECTOR

Air Pollution Control District
WILLIAM J. RODDY, APCO

Environmental Health Services Department
STEVE McCALLEY, REHS, DIRECTOR

Planning & Development Services Department
TED JAMES, AICP, DIRECTOR

AIR POLLUTION CONTROL DISTRICT

December 17, 1990

RECEIVED 2/20/91

cc: Larry Walker

Mr. Robert W. Wood, Chief
Environmental Planning and Compliance Branch
Department of the Air Force
Headquarters 6500 Air Base Wing
Edwards Air Force Base, CA 93523-5000

SUBJECT: Rule 202.1 Experimental Research Exemption for Light Exoatmospheric Project Test at Astronautics Laboratory, National Hover Test Facility (Bldg 8840)

Dear Mr. Wood:

Thank you for your November 29, 1990 letter requesting that the project described above be exempt, pursuant to Rule 202.1, from the requirements of Regulation II of the Kern County APCD Rules and Regulations.

A review of your application for an experimental research exemption revealed that you have provided the following information:

1. Statement of the project's goal,
2. Description of measures to be taken to minimize emissions,
3. Proposed installation date and planned start-up date,
4. Expected duration of project (may not exceed cumulative total of 180 days), and
5. Expected air contaminant emission testing schedule.

Because you have fulfilled the requirements of Rule 202.1, the District hereby grants an exemption for this project. Please be advised that you must provide the Kern County APCD with the following to retain your exemption:

1. Fuel consumption records must be submitted to the District, no more than 60 days after testing,
2. Cumulative record of days of operation and quantity of reactants discharged to the atmosphere must be submitted to the District monthly beginning one month after start up.

Thank you for your cooperation in this matter. Should you have any questions, please telephone Mr. Leonard Scandura of the Engineering Evaluation Section at (805) 861-3682.

Sincerely,

WILLIAM J. RODDY
AIR POLLUTION CONTROL OFFICER

Allan Phillips for

Thomas Paxson, P.E.
Manager, Engineering Division

LS/bd

Ms Claudia Nissley, Director
Western Office Project Review
Advisory Council on Historic Preservation
730 Simms Street, Room 401
Golden, Colorado 80401

13 AUG 1990

Dear Ms Nissley

The purpose of this letter is to initiate consultation with your agency under the provisions of the National Historic Preservation Act, Sections 106 and 110, and 36 CFR Part 800, regarding proposed rocket launch activities at Wake Island.

The Strategic Defense Initiative Organization (SDIO) is currently preparing an environmental assessment (EA) which supplements the Starlab and Brilliant Pebbles (BP) EAs. This EA analyzes the activities proposed to be conducted at Wake Island as well as in the continental United States (CONUS). The proposed activities include launching a liquid fueled rocket (as opposed to a solid fueled rocket) and construction of a launch pad, missile assembly building and liquid fuel storage building on Peacock Point. These activities will support both the Starlab and Brilliant Pebbles Programs and would be in addition to those proposed for the Starlab and Starbird programs. Attached is a detailed description of the proposed activities.

Previously you have been consulted on the Starlab and Starbird EAs, and approved the Data Recovery Plan (DRP) for archaeological monitoring work during project construction. SDIO plans to follow this same DRP during its construction activities to ensure avoidance of impacts to potential historic sites. In particular, we note that the Wake Island Airfield has been designated a National Historic Landmark and listed on the National Register of Historic Places (NRHP). Based on this commitment and that no elements of the National Historic Landmark listed on the NHRP will be disturbed, SDIO believes that impact within the National Historic Landmark will not be adverse.

Request your verbal opinion to Capt Gale Brown at 202 693-1833 no later than August 31, 1990. We request you follow-up your verbal opinion with a written opinion FAX to Mr Gary O'Donnell, 15 ABW/DEEN, FAX number 808 448-8951. If you have any questions, please contact our Mr Gary O'Donnell at 808 449-7520 or Capt Gale Brown at 202 693-1833.

Sincerely

Original signed by

ROSS W. J. LUM
Dep Director of Civil Engineering

1 Atch
Description of Proposed Action and Alternatives

DEEN 10 Aug 90 DEE DE

Mr O'Donnell/449-7520/ca/9Aug90/3701V

Advisory Council On Historic Preservation

The Old Post Office Building
1100 Pennsylvania Avenue, NW, #809
Washington, DC 20004

Reply to: 730 Simms Street, #401
Golden, Colorado 80401

January 16, 1991

Lt. Colonel Gordon K. W. Lee
Director of Civil Engineering
Department of the Air Force
Headquarters 15th Air Base Wing
Hickam Air Force Base, HI 96853

RE: Wake Island - Strategic Defense Initiative

Dear Lt. Colonel Lee:

We appreciate the additional maps, reports and photographs that were sent in response to our request concerning the referenced project. The Air Force has done an excellent job of considering the historic elements of the National Historic Landmark within the proposed project design. We agree that the new launch sites, the fuel, pyrotechnic and oxidizer storage shelters, and the launch support building will not adversely affect the historic properties.

Archaeological monitoring of the proposed new facilities appears to be unnecessary based upon the results of previous monitoring program conducted during construction in September 1990. All of the results were negative and it appears unlikely that additional monitoring in previously disturbed areas will produce any evidence of prehistoric occupation.

We do have one last outstanding question. There was no mention in any of the documentation about the possibility of graves or human skeletal material. Is it likely that skeletal material may be encountered or are there marked grave sites - Japanese or American ? If the possibility of inadvertent discovery exists at all, then the Air Force should plan for the reburial or removal of the remains. If you have any questions, please contact me on this matter.

Sincerely,

Claudia Nissley
Director, Western Office
of Project Review

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 15TH AIR BASE WING (PACAF)
HICKAM AIR FORCE BASE HAWAII 96853-5000

13 AUG 1990

Mr William R. Kramer
Deputy Project Leader, Environmental Services
United States Department of the Interior
Fish and Wildlife Service
300 Ala Moana Blvd
P. O. Box 50167
Honolulu, HI 96850

Dear Mr Kramer

The purpose of this letter is to initiate consultation with your agency under Section 7 of the Endangered Species Act of 1978, as amended, regarding proposed rocket launch activities at Wake Island.

The Strategic Defense Initiative Organization (SDIO) is currently preparing an environmental assessment (EA) which supplements the Starlab and Brilliant Pebbles (BP) EAs. This EA analyzes the activities proposed to be conducted at Wake Island as well as in the continental United States (CONUS). The proposed activities include launching a liquid fueled rocket (as opposed to a solid fueled rocket) and construction of a launch pad, missile assembly building and liquid fuel storage building on Peacock Point. These activities will support both the Starlab and Brilliant Pebbles Programs and would be in addition to those proposed for the Starlab and Starbird programs. Attached is a detailed description of the proposed activities (Atch 1).

Previously USFWS and the National Marine Fisheries Service have been consulted on the Starlab and Starbird EAs, and field surveys were performed during 1989 for these programs. Based on these surveys no known bird nesting areas have been reported, although there are sea bird colonies on both Wilkes and Peale Islands. These areas are greater than two miles from the proposed launch sites. The green turtle, Chelonia mydas, is the only reported threatened or endangered species in the immediate vicinity of Wake Island, and no nesting turtles have been recorded for the island. SDIO plans to follow the same construction oversight procedures (Atch 2) consistent with the Starbird and Starlab EAs. Based on this information and consistent with these commitments, SDIO believes there will be no significant impact from execution of the proposed activities.

To comply with the requirements of Section 7 of the Endangered Species Act of 1978, as amended, we are requesting your verbal opinion regarding the potential effects of the proposed activities on wildlife at Wake Island to Capt Gale Brown at 202 693-1833 no later than August 31, 1990. We request you follow-up your verbal opinion with a written opinion FAX to Mr Gary O'Donnell, 15 ABW/DEENE, FAX number 808 448-8951. The EA process must be completed no later than August 31, 1990. If you have any questions, please contact Mr Gary O'Donnell at 808 449-7520 or Capt Gale Brown at 202 693-1833.

Sincerely

ROSS W. J. LUM
Dep Dir of Civil Engineering

2 Atch
1. Description of Proposed Action and Alternatives
2. Mitigation Measure Commitments

SEP- 5-90 WED 15:30 15 CES HICKAM AFB 96853 P.04

AUG 16 '90 09:24 FWS PIA P.2/2

United States Department of the Interior

FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS OFFICE
P.O. BOX [illegible]
HONOLULU, HAWAII [illegible]

August 16, 1990

Mr. Ross W. J. Lum
Deputy Director of Civil Engineering
Headquarters, 15TH Air Base Wing
Hickam Air Force Base, Hawaii 96853-5000

Dear Mr. Lum:

This responds to your August 13, 1990 request for our review of rocket launch activities proposed for Wake Island. Specifically, you sought our concurrence that the proposed construction and operation of the launch facilities would not affect any listed or proposed endangered or threatened species of plants or animals.

We agree with your determination that the only listed species in the vicinity of the proposed launch site is the threatened green sea turtle. Although the turtle can be found in the waters surrounding Wake, it is not known to nest on the island. As such, we concur with your determination that the proposed construction and operation of the launch facilities will not affect any listed species under this Service's jurisdiction.

When in the water, listed sea turtles fall under the jurisdiction of the National Marine Fisheries Service. You should also seek their concurrence that your proposed activities will not affect any listed species under their jurisdiction.

Sincerely yours,

Ernest Kosaka

Ernest Kosaka
Field Office Supervisor
Fish and Wildlife Enhancement

cc: Gary O'Donnell, 15ABW/DEEME (By Fax only: 448-8951)
Gene Nitta, National Marine Fisheries Service, Honolulu, HI

WE ASSESSED THE IMPACT OF THIS PROJECT TO OPEN WATERS AND DETERMINED THAT THERE WOULD BE NO EFFECT TO SEA TURTLES.

— G.O'D. per phone con. w/ William Kramer
16 Aug 90 1000 808 541-2749

BRUCE KING
GOVERNOR

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HISTORIC PRESERVATION DIVISION
VILLA RIVERA, ROOM 101
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THOMAS W. MERLAN
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HELMUTH J. NAUMER
CULTURAL AFFAIRS OFFICER

RECEIVED
MAY 29 1991

May 23, 1991

Colonel William B. Christy
Director
Engineering, Housing, and Logistics
U.S. Army White Sands Missile Range
ATTN: STEWS-EL-N (Mr. Robert J. Burton)
White Sands Missile Range, New Mexico 88002-5076

Re: Lightweight Exoatmospheric Projectile (LEAP) Integrated Flight Experiment

Dear Colonel Christy:

At your request, I have reviewed the proposal to conduct the Lightweight Exoatmospheric Projectile (LEAP) Integrated Flight Experiment at White Sands Missile Range, in order to determine what effect this undertaking may have on significant cultural resources.

I concur with your determination that since the LEAP experiment will utilize existing WSMR launch facilities at Sulf Site and Launch Complex 36 and since debris from the experiment has only a very limited and unpredictable potential to affect significant historic properties, I concur with your determination the this undertaking will have no effect on cultural resources.

The greatest potential for effects on historic properties will be from any necessary efforts to recovery missile debris following the experiment. If such efforts are necessary, project personnel should be required to consult with the WSMR Environmental Office to determine the access routes and recovery methods that will reduce the potential for effects on historic properties to an acceptable level. Our previous experience with recovery operations conducted in this manner has demonstrated that these efforts can be completed with little or no effect on cultural resources.

Thank you for the opportunity to consult with you on the LEAP Experiment. Provided that you have no further questions regarding my comments, this determination of no effect should conclude our consultation on this matter.

Sincerely,

Thomas W. Merlan
State Historic Preservation Officer

TWM:DER:bc/Log 30027

5.0 REFERENCES

5.0 REFERENCES

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Office of Federal Activities
Environmental Protection Agency
401 M Street SW
Mail Code A104
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Department of Interior
Office of Public Affairs
C Street
Washington, DC 20240

Department of Energy
Director of Environment
Safety and Quality Assessment
GTN
U.S. Interstate 270
Germantown, MD 20545

PM-SNP
Department of State
Main State Building
Washington, DC 20520

National Security Council
Old Executive Office Building
Room 389
Washington, DC 20506

Arms Control and Disarmament Agency
Office of Public Affairs
320 21st Street, NW
Washington, DC 20541

Office of Freely Associated
States Affairs (FAS)
Room 5317
Department of State
22nd & C Street, NW
Washington, DC 20520

U.S. Representative Office
P.O. Box 680
Republic of the Marshall Islands
Majuro, Marshall Islands 96960

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Island Affairs
Republic of the Marshall Islands
Majuro, Marshall Islands 96960

Defense Technical Information Center
FDAC Division
Cameron Station
Alexandria, VA 22304-6145

Mr. Ron McMillam
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Washington, DC 20590
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505/526-1047

APPENDICES

APPENDIX A - BIOLOGICAL RESOURCES - WSMR AND USAKA

APPENDIX A - Threatened, Endangered, and Sensitive Species Occurring or Potentially Occurri in Otero and Dona Ana Counties, New Mexico.

Species	Status State	Status Fed	Habitat and distribution
Fishes			
White sands pupfish <u>Cyprinidon tularosa</u>	E2	2	Restricted to Salt Creek, Lost River, and Malpa and Mound Springs
Reptiles			
Texas horned lizard <u>Phrynosoma cornutum</u>		2	(**) Arid and semi-arid open country with sparse plant growth
Birds			
White-faced ibis <u>Plegadis chihi</u>		2	Irrigated land, freshwater marshes; may fly over site
Western snowy plover <u>Charadrius alexandrinus nivosus</u>		2	Alkali flats and marshes possible transient north of Lake Lucero
Mountain plover <u>Charadrius montanus</u>		2	Semi-arid grasslands, plains, plateaus
Long-billed curlew <u>Numenius americanus</u> Spring		2	High plains, rangelands, salt marshes possible transient near Malpais
Interior least tern <u>Sterna antillarum athalassos</u>	E2	E	Beaches and sandbars; has been sighted at Bosque del Apache
Ferruginous hawk <u>Buteo regalis</u>		2	(**) Arid plains, open woodlands
Swainson's hawk <u>Buteo swainsoni</u>		3C	(**) Dry plains, open foothills, rangeland, open forest
Aplamado falcon <u>Falco femoralis septentrionalis</u>		E	(*) Arid brushy prairie, yucca flats; not seen recently in New Mexico, but potential habitat exists

Species	Status State	Status Fed	Habitat and distribution
Common black hawk Buteogallus anthracinus	E2		Riparian habitat
Bald eagle Haliaeetus leucocephalus		E	Lakes and rivers; has been observed on west side of Sacramento Mountains
Mississippi kite Ictinia mississippiensis	E2		Riparian woodlands, planted groves, golf courses
Peregrine falcon Falco peregrinus anatum	E1	E	(*) Mountains and open country; has been observed on WSMR
Whooping crane Grus americana	E2	E	Freshwater streams and marshes, Bosque del Apache, may fly over site
Western yellow-billed cuckoo Coccyzus americanus occidentalis		3C	River thickets, willows, mesquite
Arizona Bell's vireo Vireo bellii	E2		Dense riparian habitat, yucca flats
Gray vireo Vireo vicinor	E2		Bushy mountain slopes, mesas, scrub, oak, juniper
Baird's sparrow Ammodramus bairdii	E2		(*) Long grass prairie; possible in playas
Varied bunting Passerina versicolor	E2		(*) Shrublands, especially dense mesquite, in canyon bottoms
Olivaceous cormorant Phalcrocorax olivaceus	E2		Breeds and resident in Rio Grande valley, transient in Alamogordo area
Willow flycatcher Empidonax traillii	E2	2	(**) Occurs statewide in spring/autumn, migrations during breeding season occurs in riparian communities

Species	Status State	Status Fed	Habitat and distribution
Mammals			
Occult (little brown) bat Myotis lucifugus occultus		2	Buildings, mine tunnels, beneath bridges, in rock crevices
Southwestern cave bat Myotis veleifer brevis		2	Caves, mine tunnels
Spotted bat Euderma maculatum	E2	2	Ranges from riparian and pinyon-juniper to spruce-fir forests; not observe east of Rio Grande
Desert bighorn sheep Ovis canadensis	E1		Arid rocky mountains in open habitat San Andres Mountains are key habitat area
Black-striped (Penasco) least chipmunk Eutamius minimus atristriatus	E1	3A	Disjunct in Sacramento Mountains, mostly in northern mountains; habitat varies, from agricultural areas to juniper woodland, ponderosa pine forest, up to lower spruce-fir zone
Organ Mountains chipmunk Eutamius quadrivittatus australis	E2	2	Southern subspecies known to occur in Organ and Oscura Mountains; occurs in ponderosa pine and juniper-oak-mixed shrub communities
Meadow jumping mouse Zapus hudsonius luteus	E2	2	Lush communities near streams and in wet meadows, from Valleys to mountains
Black-tailed prairie dog Cynomys ludovicianus arizonensis		2	Dry upland grasslands; limited to Otero: Mesa area, east of SMES-ETM site
White sands pocket gopher Geomys arenarius brevirostris		3C	Grasslands and roadsides in White Sands National Monument

Species	Status State	Status Fed	Habitat and distribution
White Sands wood rat Neotoma micropus leucophae		2	Limited to White Sands National Monument
Plants[a,b]			
Family - Apiaceae (Umbelliferae)			
Threadleaf false carrot Aletes filifolius	P1	3C	Canyons and open slopes (5500-7500 ft), in pinyon-juniper
Desert parsley Pseudocympoterus longiradiatus	P1		Sandy or rocky ground in deep canyons, usually in shade
Family - Asteraceae (Compositae)			
Spoonleaf rabbitbrush Chrysothamnus spathulatus	P1		Pinyon-juniper zone and foothills with creosote bush (4400-7000 ft)
Vasey's bitterweed Hymenoxys vaseyi	P1		Dry hills (4500-6500 ft) flowers Sept. to Nov.
Gypsum scalebroom Lepidospartum burgessii	(E),T	2	Gypseous ridges and flats (4000 ft)
Organ Mountain aster Machaerantha amplifolia	P1		Rocky canyons in mountains;(6000-7000 ft)
Nodding cliff daisy Perityle cernua	(E),T	2	Cliffs of igneous rock (5000-8800 ft)
Threadleaf horsebrush Tetradymia filifolia	P1		Limestone and gypseous soils, usually in pinyon-juniper woodland
Family - Boraginaceae			
Payson's hiddenflower Cryptantha paysonii	P1		Open slopes on limestone soils, flowers April to June (4000-7000 ft)
Family - Brassicaceae (Cruciferae)			
Gray sibara Sibara grisea	(E),T	3C	On and at the base of limestone cliffs (4500-6000 ft); flowers May-June

Species	Status State	Status Fed	Habitat and distribution
Family - Cacataceae			
Night-blooming cereus *Cereus greggi*	(E),T		(*) Gravelly or silty areas in washes or flats (3000-5000 ft); flowers June
Lee's pincushion cactus *Coryphantha sneedii leei*	(E),E	E	Rocky slopes of lime-stone mountains (4000-6000 ft); flowers April to Sept.
Sneed's pincushion cactus *Coryphantha sneedii sneedii*	(E),T	T	Limestone slopes, ledges, and ridgetops (4100-5900 ft); flowers Spring and Fall
Sheer's pincushion cactus *Coryphantha scheeri*	(E),E		(*) Open plains and flats often in alluvial soils (3000-5000 ft); flowers June to Sept
Kuenzler's hedgehog cactus *Echinocereus fendleri kuenzleri*	(E),E	E	Limestone ledges, rock cracks, and gentle slopes in or just below juniper woodland (6000 ft); flowers May
Lloyds's hedgehog cactus *Echinocereus lloydi*		E	Sandy or gravelly soils (3000 ft) population described in Jarilla Mountains currently not considered *E. lloydi* (Earnest 1989)
Villard's pincushion cactus *Escobaria villardii*	(E),T		On limestone (4500-6000 ft); known only from San Andres Mts.; flowers May-June
Sandberg's pincushion cactus *Escobaria sandbergii*	(E),T		Rocky hillsides (6000-7500 ft) flowers May-June (= *Coryphantha*)
Southwestern barrel cactus *Ferocactus wislizenii*	P1		(*) Rocky, sandy gravelly slopes in deserts, grasslands, or canyons (3000-5000 ft); flowers March to August
Wright's pincushion cactus *Mammillaria wrightii wrightii*	(E),T		(*) Gravelly or sandy hills, plains, desert grasslands to pinyon-juniper (3000-7000 ft); flowers August to October
Sandy prickly pear *Opuntia arenaria*	(E),T	2	(*) On and among sandy dunes, sandy floodplains in arroyos (3500-4500 ft.) flowers May-June
Grama grass cactus *Toumeya papyracantha*	(E),T		Sandy soils in grama grass and galleta grasslands (5000-7300 ft); flowers April-June (= *Pediocactus*)

Species	Status State	Status Fed	Habitat and distribution
Family - Caryophyllaceae			
Plank's catchfly <u>Silene plankii</u>	P1	3C	Crevices and pockets in protected cliff faces of igneous rock (5000-6500 ft) flowers July to September
Family - Cucurbitaceae			
Smooth cucumber <u>Sicyos glaber</u>	P1		(*) Lower to middle elevations of Organ Mountains (5000-6000 ft) flowers July to September
Family - Euphorbiaceae			
Candelilla <u>Euphorbia antisyphilitica</u>	(E)		Locally abundant in limestone deserts and gravelly slopes; flowers June-July
Family - Fabaceae (Leguminoseae)			
Castetter's milkvetch <u>Astragalus castetteri</u>	P1	3C	Limestone soils in pinyon-juniper, canyons and dry washes of western slopes of San Andres Mts.;(5000-6000 ft)
Guadalupe Mountain <u>Sophora gypsophila guadalupensis</u>	(E),T	2C	Dry limestone slopes with one seeded mescal bean juniper (5000-6400 ft)
Family - Hydrophyllaceae			
Cliff nana <u>Nama xylopodum</u>	P1	3C	Cracks and crevices of limestone boulders and scarps (4500-6000 ft) flowers May to September
Family - Lamiaceae (Labiatae)			
Grayish white giant hyssop <u>Agastache cana</u>	P1		On rocky slopes and in crevices of ledges in low mountains (5250-6225 ft); flowers mid-July to August
Todsen's pennyroyal <u>Hedeoma todsenii</u>	(E),T	E	In gravelly limestone soils on steep slopes under scattered pines (6600 ft)
Supreme sage <u>Salvia summa</u>	T		Shaded ledges and cracks among rocks on steep limestone canyon slopes (5000 ft)

Species	Status State	Status Fed	Habitat and distribution
Family - Loasaceae			
Gypsum blazing star Mentzelia perenis	P1		Gypsum deposits, limestone hills with gypsum lenses in lower juniper zone (5400 ft)
Family - Malvaceae			
Wright's globemallow Sphaeralcea wrightii	T		Rocky slopes in arid grassland or desert (4000-6000 ft); flowers July to September
Family - Martyniaceae			
Dune unicorn plant Proboscidea sabulosa	(E),T	3C	(*) Deep sands of mostly stabilized dunes, desert scrub, often with mesquite (3000- 3500 ft)
Family - Onagraceae			
Organ Mountains evening primrose Oenothera organensis	T	2	Restricted to seeps and springs (5700-7600 ft)
Family - Papaveraceae			
Sacramento prickly poppy Argemone pleiacantha pinnatisecta	(E),E	E	Rocky canyon bottoms and slopes (5000-7000 ft); flowers May to August
Family - Plumbaginaceae			
Blue limonium Limonium limbatum	(E)	3C	In saline flats, depressions, associated with alkaline soils (3000-6000 ft); flowers June to August
Family - Poaceae			
Curlleaf needlegrass Stipa curvifolia	T	3C	Limestone rims and steep slopes (4000-5600 ft); flowers April to May
Family - Polygalaceae			
Mescalero milkwort Polygala rimulicola mescalerorum	(E),T	2	Cracks of sandy, limestone cliffs (5100 ft); flowers June to September

Species	Status State	Status Fed	Habitat and distribution
Family - Portulacaeae			
Longstemmed talinium <u>Talinum longipes</u>	(E),P1		(*) Dry hills at lower elevations; flowers July to August
Family - Scrophulariaceae			
Alamo beard tongue <u>Penstemon alamoensis</u>	(E),T	2	Canyon bottoms, crevices, and pockets in rocky limestone hillsides (5000 ft); flowers May to June

(**) Known to occur in mesquite sand dune habitat type (BLM IHICS system).

(*) Habitat of White Sands Missile Range SMES-ETM site appears suitable for occurrence.

(a) Only plant species occurring below 6000 ft are included in this list.

(b) Status (E) refers to category of New Mexico Natural Resources (1985): other state status categories are from New Mexico Native Plants Protection Advisory Committee (1984).

Sources:

Earnest 1989
New Mexico Department of Game and Fish 1988
New Mexico Native Plants Protection Advisory Committee 1984
New Mexico Natural Resources Department 1985
New Mexico Natural Resources Department 1989
Norwick 1989
U.S. Army 1987
U.S. Army 1989
USFWS 1987a
USFWS 1987b
USFWS 1989

Status Codes

State:
(Categories used by New Mexico Game and Fish Department)

E1	Endangered (group 1) -	Animal species whose prospects of survival or recruitment within the state are in jeopardy.
E2	Endangered (group 2) -	Animal species whose prospects of survival or recruitment within the state are likely to become jeopardized in the foreseeable future.

(Category used by New Mexico Natural Resources Department)

(E)	Endangered -	Plant taxon which is on the federal list of threatened or endangered species; or species which are rare or widespread across their entire range but whose survival in New Mexico is jeopardized.

(Categories used by New Mexico Native Plants Protection Advisory Committee 1984)

E	Biologically endangered -	Plant taxon of very restricted distribution and which is seriously declining and in danger of rapid extinction throughout its range.
T	Biologically threatened -	Plant taxon of restricted distribution or which has potential for rapid extinction throughout all of its range.
P1	Priority 1 -	Endemic or of restricted distribution in New Mexico, being commercially exploited, and usually being eradicated in much of its historic range.

Federal:

E	Endangered -	A species in danger of extinction throughout all or a significant portion of its range.
T	Threatened -	A species which is likely to become endangered within the foreseeable future.
2C	Candidate, category 2 -	Information indicates that proposing to list as endangered or threatened is possibly appropriate, but substantial data on biological vulnerability and threats are not currently known to support the immediate preparation of rules. Further biological research and field study will be necessary to ascertain the status and/or taxonomic validity of the taxa in Category 2.
3	Candidate, category 3 -	Former candidate, rejected because persuasive evidence of extinction (3a), does not represent taxa meeting legal definition of Endangered Species Act (3b), or more widespread than previously thought (3c).

APPENDIX B
AIR MODELING ANALYSIS

LEAP Air Quality Impact Assessment

INTRODUCTION

The LEAP program is designed to test the tracking and control ability of an infrared seeker guidance control system. Aries booster rockets will launch Lightweight Exoatmospheric Projectiles (LEAP) for use in this testing. The ability of this system to divert a Space Test Projectile and intercept targets will be of primary concern in this project. This air quality impact assessment is to estimate the environmental impacts that could be expected from the pre-launch and launch activities at the launch location: White Sands Missile Range (WSMR).

CHARACTERISTICS OF LAUNCH VEHICLES

The LEAP flight vehicle for two of the tests will consists of a one-stage Aries booster, the LEAP payload, a nose cone, and other components (e.g., interstages, skirts, etc.) necessary to assemble and launch the LEAP. The following describes those components of the LEAP booster vehicle that have the potential to emit significant pollutants to the atmosphere.

First Stage Aries Booster

The first stage, and the only stage for most of the LEAP test launches, is an Aries rocket motor (M56A1). This solid propellent motor was developed for the second stage of the Minuteman missile. The following are the physical characteristics of this Aries first stage rocket:

Aries Stage I Rocket Characteristics

Length (Inches)	155.50
Diameter (Inches)	44.53
Burn Time (seconds at 80°F)	58.77
Max. Thrust (Lb)	50,300
Weight Total (Lb)	11,399
Propellent Weight (Lb)	10,370
Burnout Altitude (Km)	50-60
Range at Burnout (Km)	10

Second Stage Aries Booster

The second stage of the launch vehicle is also a previous minuteman rocket. This M57A1 booster was used as the third stage of the Minuteman ICBM Weapon System. The second stage Aries has the following physical characteristics:

Aries Stage II Rocket Characteristics

Length (Inches)	85.25
Diameter (Inches)	38.00
Burn Time (seconds at 80°F)	48.00
Average Thrust (Lb)	22,000
Weight Total (Lb)	4,305
Propellent Weight (Lb)	3,665
Burnout Altitude (Km)	140-150
Range at Burnout (Km)	10

Payload Projectile

The payload projectiles consist of a Target Boost Assist Module (TBAM), Free Flyer Observation Vehicle, and a Cold-Body Target. The target is powered by a cold-gas nitrogen altitude control-system, and a fast-burning solid rocket motor. The free-flyer projectile has a nitrogen tetroxide (N_2O_4) liquid propulsion system. Because of the high altitude when this propulsion is used during normal launches and the relatively small quantity of these fuels, all of the payload projectiles have been assumed to have insignificant contributions to the exhaust for both operational and accident conditions.

Other Components

The nose cone, interstage, and other rocket components necessary to assemble the LEAP launch vehicle are assumed not to produce air emissions during normal launches. They are expected to fragment into small particles or produce insignificant air emissions during an accidental detonation at or near the ground. Therefore, these components are not considered in the following air impact assessment.

AIR EMISSIONS

The assessment of ambient air impacts from the operation of the LEAP program considers the normal and accidental emissions during pre-launch and launch: i.e., while the LEAP launch vehicle is on the launch pad in a "go" condition. This section describes the conditions that exist, or are assumed, during these two pollutant emission scenarios. The differences between the two modeled release scenarios are:

- Emissions occur over a much shorter time period for an accident.
- Accidental releases are initially at ground level while launches have releases over an assumed conservatively small path of 1.09 km in altitude.

- Total two stage LEAP launch vehicle is included in an accidental release scenario while only the first stage emissions are used for the normal launch configuration. No exhaust cooling occurs with the larger heat release in an accident. Exhaust cloud heights for an accidental mode, because of the larger energy released, can be 2 to 3 times that for a normal launch.
- Combustion pollutants are released in a linear path for a launch while a radial expansion of the emissions occurs for an accidental detonation.

Normal Launch Scenario

During the routine launch of a LEAP vehicle only the first stage Aries emissions will be of concern for ground level receptors about the launch facility. Because the second stage Aries emissions will not begin until the LEAP vehicle has reached 50-60 km in altitude and about 10 km down range, these emissions will not produce significant concentrations at surface stations.

The following are launch characteristics that have been used or assumed in the air impact analysis:

1) Because of the Aries rocket will be under constant acceleration, more of the exhaust will be emitted in the initial near ground level portion of the flight.

2) Exhaust temperature will cause the pollutants to rise and have additional dispersion.

3) No fallout or deposition of the emissions is considered.

4) The launch can occur any time of the day and any day of the year. Estimated bounding-case meteorology was used rather than actual measurements at the site. (Unstable atmospheric conditions with wind speed equal to 1 meter per second for elevated releases and stable atmospheric conditions and 1 meter per second winds for the bounding-case ground level scenario.)

5) Although re-circulation of pollutants is possible, the highest short-term concentration will occur as the exhaust cloud initial passes over the receptors of interest (i.e., direct line transport to the receptor). The longer travel time before reaching the receptors during re-circulation will permit further dispersion of the cloud and only contribute to long-term average concentrations.

6) Because of the temperature in the cloud and subsequent mixing, the conversions of H_2 to H_2O, CO to CO_2 and N_2 to NO and NO_2 are considered. (Note: Conversion of free N_2 to NO in the high temperature cloud was not considered in the analysis.)

7) Exhaust rocket plumes have been observed or calculated to reach heights of 2,000 to 3,500 feet. Conservative exhaust cloud heights have been incorporated in the analysis.

Accidental Launch Scenario

To account for the maximum release of pollutants, the accidental release scenario is associated with a launch pad detonation of a two stage booster missile. This scenario will produce the maximum impacts for ground level receptors because the fuels associated with both stages are involved. The following are the characteristics that have been used or assumed in the air impact analysis of an accidental detonation of the LEAP launch vehicle on the launch pad:

1) Although the solid rocket fuel is expected to burst and fragment and thereby result in less than total burn, the bounding-case impact analysis assumes full burning of the fuel.

2) The exhaust cloud will, because of the heat generated, rise rapidly to a heights in excess of those expected during normal launch.

3) Emission cloud will expand rapidly in all radial directions to a value about ten times the initial dimension.

Transport and Dispersion Estimates

The impact assessment of the normal launch and accidental detonation of the LEAP launch vehicle involves the determination of expected concentrations of the emitted pollutants at important locations about the facility. Comparison of the expected concentrations with applicable ambient air quality standards and permissible exposure guideline values will indicate if air quality problems are expected with the LEAP program (References: National Ambient Air Quality Standards; American Conference of Governmental Industrial Hygienists; and Occupational Safety and Health Administration).

The transport and dispersion assessment has three components that are of critical importance in the determination of the

expected concentrations associated with the air emissions from the LEAP launch vehicle: 1) Source emission characteristics under the two scenarios, 2) Initial exhaust cloud physical characteristics (e.g., initial exhaust cloud dimensions, height, temperature, etc.), and 3) Dispersion/Transport model used to represent the process.

Source Emission Characteristics

The combustion products associated with the first and second stages of the LEAP launch vehicle are given in Table 1. (Reference: M56A1 and M57A1 specification sheets) In terms of the normal operation, the first stage Aries emission values are used in the impact assessment. Stage 2 emissions will occur at an altitude and distance down range that will make their contribution to the ground level air quality impacts insignificant. The accidental release scenario includes the total LEAP launch vehicle emissions; i.e., Aries first and second stage emissions.

The combustion products of nitrogen (N_2), carbon monoxide (CO), and hydrogen (H_2) will further change in the high temperature "afterburning" exhaust to NO and NO_2, CO_2, and H_2O, respectively. For the normal high temperature rocket exhaust it has been conservatively assumed that the nitrogen and hydrogen are all converted to nitrogen oxide and water. Because of the lower exposure standard for CO compared to CO_2, no conversion of CO to CO_2 has been assumed.

In summary, the following have been assumed in the air quality impact analysis:

- No conversion CO to CO_2.
- All H is converted to H_2O.
- All N_2 is initially converted to NO. Based on the previous analysis of Titan IV solid rocket exhaust products, 10 percent of the NO has been assumed to be further converted to NO_2.

Table 2 presents the resultant emissions used for the normal launch and accidental release scenarios.

Initial Exhaust Clouds

The critical initial exhaust cloud dimensions and height of release were estimated from information available on rockets tests and other launch measurements or studies. Analysis of Titan rocket tests have shown the exhaust to rise to 3,500 to 4,900 feet. It is expected that the

exhausts from an accidental detonation will rise to a much higher altitude due to the larger amount of heat released in the absence of water cooling.

The normal launch is assumed to have the combustion products distributed over a trail of about 1 km in altitude. This exhaust cloud is estimated to have a horizontal radius of about 5 meters. High temperature rocket exhausts have been observed and calculated to rise to altitudes of 1,000 meters depending on the wind speed and atmospheric stability. Conservative calculation of the rise of the LEAP exhaust cloud yields altitudes of from 100 to 400 meters.

Considering these observations and calculations, the normal launch release scenario used a conservative release cloud altitude of 200 meters with an initial cloud dimension of 5 meters in radius and 100 meters in vertical extent.

The accidental release scenario will occur with the vehicle on the launch pad. All stages and payload emissions will occur simultaneously. The larger heat release for this scenario will cause the cloud to rise to higher altitudes. The exhaust products will be disbursed in all radial directions. The exhaust cloud has been conservatively assumed to be 10 meters in radius and have a release altitude of 200 meters.

<u>Dispersion and Transport Model</u>

The model used to represent the dispersion and transport is a PUFF model using quasi-instantaneous dispersion parameters (W. B. Petersen, 1982). This computer model was developed for application to accidental release of hazardous chemicals. The model calculates maximum (i.e., centerline) ground level concentrations using a Gaussain instantaneous model with initial horizontal and vertical dimensions. It is a neutral buoyant release model so that the final release height is used. Such a model has been used for the assessment of exhaust clouds from test firing of the solid fuel Titan IV rockets (Environmental Assessment - Titan IV, 1988).

LEAP AIR QUALITY IMPACT ESTIMATES

The PUFF model was run for both the normal launch and accident release modes as described in the previous sections. The output of the PUFF model runs are presented in Tables 3 and 4 for the normal and accident scenarios, respectively. To provide pollutant dependent concentrations for representative points of interest, calculations were performed for distances of 0.5, 1.0, 3.0, 5.0, and 10.0 kilometers from the launch pad. Concentrations are provided for each averaging period of interest

(i.e., for averaging periods associated with the short-terms comparison concentration values presented in Table 5) for each pollutant. Also provided in Tables 3 and 4 are the applicable comparison standards and total mass of the released pollutants for each scenario.

Table 3 indicates concentrations associated with the normal launch exhaust pollutants are all much less than the applicable ambient air quality standards, threshold limit values, or permissible exposure limits. This is also true of the estimated concentrations for the accident scenario presented in Table 4.

As a bounding-case estimate of the potential air quality impact from the normal launch and accident release of pollutants, a PUFF model run was made assuming all the exhaust is emitted at ground level with no buoyant cloud rise for the normal launch scenario and the exhaust cloud at only 100 meters for the accident scenario. This bounding-case scenario assumes that the heat is dissipated quickly preventing the rise of the exhaust cloud. Because only ground level dispersion and transport is considered for normal launch, 1 meter per second wind speed and stable atmospheric conditions were used. Tables 6 and 7 present the result of these model runs for the normal and accident release modes.

The modeled concentrations for the bounding-case, normal release mode scenario produced nitrogen dioxide and particulate matter values exceeding guideline values: nitrogen dioxide 15-minute concentrations at 0.5 km; instantaneous concentrations of nitrogen dioxide at locations 1.0 km or less from the launch pad; and particulate 24-hour concentrations at 1 km or less. The bounding-case accident release mode also revealed nitrogen dioxide concentrations as exceeding the guideline values: instantaneous nitrogen dioxide values at distances of 1 km or less. The small number of modeled concentrations exceeding the applicable concentration standards under the worst possible modeling scenarios indicate the unlikely potential of air quality problems developing from the operation of the LEAP program.

SUMMARY

Conservative estimates of ground level concentrations of the pollutants resulting from the normal LEAP launching and potential launch pad accident were developed using a quasi-instantaneous PUFF transport and dispersion model. This modeling indicated no concentration exceeding applicable short-term standards and guideline concentrations. The magnitude of the releases, the area over which the pollutants are initially dispersed, and the buoyant nature of exhaust products all contribute to the small magnitude of the expected ground level impact.

Bounding-case estimates were also developed from the PUFF model analysis assuming an unlikely non-buoyant exhaust cloud for operational releases and 100 meter cloud height for the accident scenario. This bounding-case modeling resulted in nitrogen dioxide concentrations exceeding the ACGIH 15-minute guideline value at 0.5 km for the operational scenario and the OSHA instantaneous ceiling value for receptors 1 kilometers or less downwind of the launch pad for both the normal and accident release modes. The 24-hour particulate standard was also exceeded at these short-distance receptors in the normal launch mode.

Based on the results of the PUFF modeling it is expected that the operation of the LEAP program will not present air quality problems. Both conservative elevated buoyant cloud modeling and the unlikely bounding-case modeling supports this conclusion.

TABLE 1
TOTAL EMISSIONS FROM A LEAP FLIGHT

COMBUSTION PRODUCT	ARIES FIRST STAGE M56A1[1] (lb)	ARIES SECOND STAGE M57A1[2] (lb)	TOTAL EMISSIONS TWO STAGES (lb)
Aluminum Oxide ($A1_2O_3$)	850	389	1,240
Carbon Monoxide (CO)	2,458	1,535	3,993
Carbon Dioxide (CO_2)	176	770	946
Hydrogen (H_2)	3,215	1,046	4,261
Hydrogen Chloride (HC1)	1,483	105	1,587
Nitrogen (N_2)	788	567	1,355
Water (H_2O)	1,338	283	1,621

[1] Single Aries stage launch booster for most flights.
[2] One launch contains two-stage Aries rocket booster. (M57A1 specifications indicate exhaust emissions at 109 percent of propellant weight.)

TABLE 2
LEAP EMISSIONS FOR NORMAL
LAUNCH AND TWO STAGE ACCIDENTAL RELEASE SCENARIOS

POLLUTANT	NORMAL LAUNCH (lb)	ACCIDENT (lb)
Aluminium Oxide	850	1,240
Carbon Monoxide	2,458	3,993
Carbon Dioxide	176	946
Nitrogen Dioxide	259	445
Hydrogen Chloride	1,483	1,587
Nitric Oxide	1,520	2,613
Particulate Matter	850	1,240

TABLE 3
ESTIMATED CONCENTRATIONS FROM
NORMAL LAUNCH CONDITIONS (mg/m³)

Pollutant	Average Period	Guideline (mg/m³)	Release (lb)	Distance Downwind (km)				
				0.5	1.0	3.0	5.0	10.0
Aluminum Oxide	8 hours	5	850	0.02	0.06	0.06	0.03	0.02
Carbon Monoxide	8 hours	10	2,458	0.06	0.17	0.17	0.10	0.05
	1 hour	15		0.40	1.37	1.35	0.78	0.37
	15 minutes	458		1.78	5.48	5.16	2.51	0.74
Carbon Dioxide	8 hours	18,000	176	0.00	0.01	0.01	0.01	0.00
	15 minutes	54,000		0.13	0.39	0.37	0.18	0.05
Nitrogen Dioxide	8 hours	5.6	259	0.01	0.02	0.02	0.01	0.00
	15 minutes	9.4		0.19	0.58	0.54	0.26	0.08
	Instantaneous	9		1.59	2.58	0.92	0.33	0.08
Hydrogen Chloride	8 hours	7	1,483	0.03	0.10	0.10	0.06	0.03
Particulate Matter	24 hours	0.15	850	0.01	0.02	0.02	0.01	0.01
Nitric Oxide	8 hours	30	1,520	0.03	0.11	0.10	0.06	0.03

Note: Concentrations less than 0.005 mg/m³ are noted as "0.00".

TABLE 4
ESTIMATED CONCENTRATIONS FROM TWO-STAGE ACCIDENT CONDITIONS (mg/m^3)

Pollutant	Average Period	Guidelines (mg/m^3)	Release (lb)	Distance Downwind (km) 0.5	1.0	3.0	5.0	10.0
Aluminum Oxide	8 hours	5	1,240	0.00	0.00	0.04	0.03	0.02
Carbon Monoxide	8 hours	10	3,993	0.00	0.00	0.13	0.11	0.07
	1 hour	15		0.00	0.03	1.03	0.90	0.50
	15 minutes	458		0.00	0.12	3.96	2.87	1.19
Carbon Dioxide	8 hours	18,000	946	0.00	0.00	0.03	0.03	0.02
	15 minutes	54,000		0.00	0.03	9.37	0.68	0.28
Nitrogen Dioxide	8 hours	5.6	445	0.00	0.00	0.01	0.01	0.01
	15 minutes	9.4		0.00	0.01	0.44	0.32	0.13
	Instantaneous	9		0.00	0.06	0.75	0.41	0.14
Hydrogen Chloride	8 hours	7	1,587	0.00	0.00	0.05	0.04	0.03
Particulate Matter	24 hours	0.15	1,240	0.00	0.00	0.01	0.01	0.01
Nitric Oxide	8 hours	30	2,613	0.00	0.00	0.08	0.07	0.05

Note: Concentrations less than 0.005 mg/m^3 are noted as "0.00".

TABLE 5

AMBIENT AIR QUALITY STANDARDS, THRESHOLD LIMIT VALUES, AND PERMISSIBLE EXPOSURE LIMITS FOR LEAP EXHAUST POLLUTANTS

Pollutant	National Ambient Air Quality Standards		American Conference of Government Industrial Hygienists (ACGIH); Occupational Safety & Health Administration (OSHA)
Aluminum Oxide	(As Particulate) 75 $\mu g/m^3$ (primary) 60 $\mu g/m^3$ (secondary) 260 $\mu g/m^3$ (primary) 150 $\mu g/m^3$ (secondary)	 Annual Annual 24-hours 24-hours	(As Aluminum) 15 mg/m^3 8-hours-Dust (OSHA) 5 mg/m^3 8-hours-Respirable (OSHA)
Carbon Monoxide	10,000 $\mu g/m^3$ (9ppm) 40,000 $\mu g/m^3$ (35 ppm)	8-hours 1-hour	40 mg/m^3 (35 ppm) 8-hours (OSHA) 458 mg/m^3 (400 ppm) 15-minute (ACGIH) 229 mg/m^3 (200 ppm) Ceiling (OSHA)
Carbon Dioxide	---		18,000 mg/m^3 (10,000 ppm) 8-hours (OSHA) 54,000 mg/m^3 (30,000 ppm) 15-minute (OSHA)
Lead	1.5 $\mu g/m^3$	3-months	0.150 mg/m^3 8-hours (ACGIH)
Nitrogen Dioxide	100 $\mu g/m^3$	Annual	5.6 mg/m^3 (3 ppm) 8-hours (ACGIH) 9.4 mg/m^3 (5 ppm) 15-mins (ACGIH) 9 mg/m^3 (5 ppm) Ceiling (OSHA)
Hydrogen Chloride	---		7 mg/m^3 (5 ppm) Ceiling (OSHA)
Nitric Oxide	---		30 mg/m^3 (25 ppm) 8-hours (OSHA)

TABLE 6
BOUNDING-CASE CONCENTRATION ESTIMATES FROM NORMAL LAUNCH CONDITIONS (mg/m^3)

Pollutant	Average Period	Guidelines (mg/m^3)	Release (lb)	Distance Downwind (km) 0.5	1.0	3.0	5.0	10.0
Aluminum Oxide	8 hours	5	850	2.02	0.64	0.11	0.05	0.02
Carbon Monoxide	8 hours	10	2,458	5.84	1.86	0.30	0.13	0.05
	1 hour	15		*46.7	14.9	2.43	1.05	0.36
	15 minutes	458		187	59.7	9.32	3.34	0.74
Carbon Dioxide	8 hours	18,000	176	0.42	0.13	0.02	0.01	0.00
	15 minutes	54,000		13.4	4.28	0.67	0.24	0.05
Nitrogen Dioxide	8 hours	5.6	259	0.62	0.02	0.03	0.01	0.00
	15 minutes	9.4		*19.7	6.29	0.98	0.35	0.08
	Instantaneous	9		*166	*28.0	1.66	0.45	0.08
Hydrogen Chloride	8 hours	7	1,483	3.52	1.12	0.18	0.08	0.03
Particulate Matter	24 hours	0.15	850	*0.67	*0.22	0.04	0.02	0.01
Nitric Oxide	8 hours	30	1,520	3.61	1.15	0.19	0.08	0.03

* Concentration Exceeds Standard

Note: Concentrations less than 0.005 mg/m^3 are noted as "0.00".

TABLE 7
BOUNDING-CASE CONCENTRATIONS ESTIMATES
FROM ACCIDENT TWO-STAGE CONDITIONS (mg/m^3)

Pollutant	Average Period	Guidelines (mg/m^3)	Releasa (lb)	Distance Downwind (km) 0.5	1.0	3.0	5.0	10.0
Aluminum Oxide	8 hours	5	1,240	0.39	0.45	0.13	0.06	0.02
Carbon Monoxide	8 hours	10	3,993	1.25	1.44	0.43	0.20	0.07
	1 hour	15		9.98	11.5	3.40	1.59	0.60
	15 minutes	458		39.9	46.3	13.1	5.03	1.19
Carbon Dioxide	8 hours	18,000	946	0.30	0.34	0.10	0.05	0.02
	15 minutes	54,000		9.46	11.0	3.09	1.19	0.28
Nitrogen Dioxide	8 hours	5.6	445	0.14	0.16	0.05	0.02	0.01
	15 minutes	9.4		4.45	5.16	1.46	0.56	0.13
	Instantaneous	9		*37.5	*22.9	2.46	0.72	0.14
Hydrogen Chloride	8 hours	7	1,587	0.50	0.57	0.17	0.08	0.03
Particulate Matter	24 hours	0.15	1,240	0.13	0.15	0.04	0.02	0.01
Nitric Oxide	8 hours	30	2,613	0.82	0.94	0.28	0.13	0.05

* Concentration Exceeds Standard
Note: Concentrations less than 0.005 mg/m^3 are noted as "0.00".

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